THE

AMERICAN NATURALIST

VOL. XXX. July, 1896. 355

THE CLASSIFICATION OF DIATOMS (BACILLARIACEÆ).[1]

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There have been many systems of classification employed for the *Bacillariaceæ*, but very few of these have any valid claim, to be regarded as natural systems. They may be divided into three classes; (1) those based on the structure of the valves, of which Kuetzing's, Prof. H. L. Smith's, and that employed by Kirchner are examples; (2) those based on the form of the frond, the connecting membrane, and the gelatinous envelope, represented by Rev. Wm. Smith's; and (3) those based on the structure of the endochrome and the manner of forming auxospores, represented by that of Paul Petit. The following is a brief outline of the systems mentioned.

Kirchner divided the *Bacillariaceæ* into two groups[2] those whose markings are bilateral, that is, arranged on two sides of a longitudinal line or raphe, and[3] those with radial markings.

[1] Read before the Botanical Seminar of the University of Nebraska, March 21. 1896.

[2] Kryptogamen-Flora von Schlesien; Algen, 171 Breslau, 1878.

[3] Species Algarum, 1. Leipsic, 1849.

Those with bilateral markings he divided into two subdivisions the first comprising those with a central nodule, and the second those with none.

Kuetzing divided the *Bacillariaceæ* into three tribes; I, *Striatæ,* that is those with transverse striations; II, *Vittatæ*, that is those with longitudinal stripes; and III, *Areolatæ*, that is those whose surfaces are divided into angular areolæ. The first-two tribes, *Striatæ* and *Vittatæ* he divided into two orders each, viz.; I, *Astomaticæ* and II, *Stomaticæ*. The *Astomaticæ* included those with no central nodule, or as he understood it, with no central opening, while the *Stomaticæ* included those with a central nodule. If the central nodule were really a stoma or aperture as Kuetzing considered it, this grouping might have been a natural one; for this difference in structure might have connoted important physiological differences, but it is generally conceded that the nodules are merely markings on the valves, and it is likely that they indicate nothing as to the physiology of the plant. So no higher groups than genera, or possibly species, can be based on this character. His third tribe, *Areolatæ*, he also divided into two orders; I, *Disciformæ* that is, those of a circular or angular form, and, II, *Appendiculatæ*, or forms with appendages, as *Biddulphia.*

The classification of Prof. H. L. Smith[4] is one that has had considerable following. Bessey's Botany[5] was the first American textbook to adopt and give an outline of the system. It was adopted by Van Heurck[6], Wolle[7] and De Toni[8]. To say the least, it is a good practical system of classification, and probably this is the most that can be said for it, though in some points it seems to approach a natural system. Smith divides the Diatoms into three tribes, the *Raphideæ, Pseudoraphideæ,* and *Cryptoraphideæ.* The *Raphideæ* are all supposed to possess a raphe. The *Pseudoraphideæ* are usually elongated, have no raphe, but in its place there is a blank space resembling a

[4] Conspectus of the Families and Genera of the Diatomaceæ in *The Lens,* I: 1 1872 and II: 65, 1873.

[5] Botany for High Schools and Colleges, Henry Holt and Co, New York, 1880,

[6] Synopsis des Diatomées de Belgique, 1885.

[7] Diatomaceæ of North America, 1890.

[8] Sylloge Algarum, 1891.

raphe. The *Cryptoraphideæ* are usually circular or angular and have nothing resembling a raphe. Upon the supposition that the raphe is an essential organ, and that it is present in one tribe, replaced by another structure in the second, and "hidden" in the third, this might be a natural classification. But if the raphe is known to exist only in the first tribe and its existence in the others is wholly theoretical, it will hardly serve as a character on which to base a classification. It is true that the genera brought together by this system appear to bear more or less relation to each other, but if we knew as little about Phanerogams as we do about Diatoms, we should think that a division of them into *Arboræ, Frutices,* and *Herbæ* placed related genera together, for it would be easy to see that *Salix* and *Populus* are related, and also that *Solanum* and *Physalis* are more or less closely allied. I venture to regard the *Raphideæ, Pseudoraphideæ,* and *Cryptoraphideæ* as having no greater naturalness than the divisions *Arboræ, Frutices,* and *Herbæ;* and it is to be hoped that they will soon be consigned to the same botanical limbo in which the latter have long since found obscurity.

It is true, however, that in the *Raphideæ,* there seems to be a trace of naturalness in the system. The author begins with the bilaterally symmetrical forms, that is those in which the raphe is a median line, as for example, *Navicula.* Those with the raphe at one side of the center, as in *Cymbella,* he considers a modification of the first type by a curving of the frustule and thus bringing the raphe nearer the concave side. And in the third division the raphe has approached so near to the concave margin that it fuses with it, as in *Amphora.* If this is to be considered simply as a modification of a typical form, it means little. But if this modification shows the course of development from the *Navicula* form to the *Amphora* form, it means a great deal. In *Navicula* and *Cymbella* two auxospores are formed from two mother cells without conjugation, and in *Amphora* two auxospores are formed from two mother cells by conjugation. It is probable that the method of reproduction found in the derived form is a development from that found in the primitive form. If then the *Amphora* form has developed from the *Navicula* form, there is reason to believe that the for-

mation of auxospores without conjugation is the primitive method, although Murray[9] holds that the formation of auxospores by conjugation is probably the original method, and that their formation without conjugation is the derived method.

Wm. Smith[10] divided the Diatoms into two tribes in the first of which the frustules are free, and in the second imbedded in a gelatinous envelope. Under the first tribe he makes five subtribes, depending upon the form of the connecting membrane and the relation of the frustules to each other. The second tribe he divided into four subtribes based on the form of the fronds. This arrangement seems not only extremely artificial but also very impractical. Nothing about Diatoms is more variable than the form of the fronds; and where it is at all constant, such a system places closely related genera far apart; for example, *Cymbella* and *Encyonema*, *Nitzschia* and *Homœocladia* are placed in separate tribes, while in structure they are very similar, the main difference being that in *Encyonema* and *Homœocladia* the frustules are arranged in rows, while in *Cymbella* they are free or stipitate and in *Nitzschia* they are free. This method of classifying Diatoms may be likened to a separation of Grasses into those forming a dense sod and those not forming a sod; or of Dicotyledons into those exuding a resinous fluid and those that do not. Wm. Smith places *Gomphonema* in his first tribe, that is, the one having no gelatinous envelope; but some species of *Gomphonema* are stipitate while others are enclosed in an amorphous mass of jelly. The latter species would have to be placed in his second tribe, thus dividing the genus. It would lead to even greater difficulty than this, for the same species is sometimes stipitate and sometimes imbedded in a gelatinous envelope.

Of all existing systems that of Paul Petit[11] seems to approach

[9] An Introduction to the Study of Seaweeds, p. 195, 1895.

[10] For a synopsis of Smith's classification see Pritchard's History of the Infusoria, 101, fourth edition, 1861.

[11] Liste des Diatomées et des Desmidées observées dans les Environs de Paris precedée d'un essai de classification des Diatomées. Bull. Soc. Bot. France, tom. XXIII–XXIV, Paris, 1877.

An Essay on the Classification of the Diatomaceæ translated by F. Kitton, Monthly Microscopical Journal and Transactions of the Royal Microscopical Society, XVIII, 1877, pp. 10, 65.

Pfitzer, Die Bacillariaceen, in Schenk's Handbuch der Botanik, Breslau, 1882.

most nearly to a natural one because it is based on characters having physiological significance. It is based primarily on the structure of the endochrome, and secondarily on the method of forming auxospores and the general shape of the frustules. Van Heurck does not employ this system in his *Synopsis* because of the large number of fossil specimens and those from deep-sea soundings to which it could not be applied. But this is not a valid objection, for all the genera are represented by modern species, and these are sufficient for a basis of classifications, and since the specific characters are based mainly on the structure of the valves, there will be no trouble with the fossil forms. The following synopsis of Petit's system includes the higher divisions only.

I. *Bacillariaceæ coccochromaticæ.*

With numerous endochrome granules.

- A. Frustules concentrically constructed. One mother cell forming asexually a single auxospore. *Melosireæ*, etc.
- B. Frustules bilateral, one or two mother cells forming two auxospores, as far as known asexually. *Fragilarieæ*, etc.

II. *Bacillariaceæ placochromaticæ.*

With one or two large endochrome plates.

- A. One endochrome plate lying against the convex valve; one mother cell forming one auxospore asexually. *Cocconeideæ.*
- B. A single endochrome plate extending diagonally across the cell cavity, or lying next the girdle. Two auxospores formed from two mother cells, with or without conjugation. *Nitzschieæ. Amphoreæ, Cymbelleæ*, etc.
- C. Two endochrome plates lying next the two valves. Two mother cells forming two auxospores by conjugation. *Eunotieæ, Synedrieæ, Surirayeæ.*
- D. Two endochrome plates lying next the two girdle bands; two mother cells forming two auxospores without conjugation. *Amphipleureæ, Naviculeæ*, etc.

Although Petit's system is by no means perfect, it is at least a step in the right direction. He bases it upon characters that have some physiological significance, while the other systems are wholly or in greater part based on merely accidental characters. A clue to the genetic relationships of Diatoms, as of other plants, will be most certainly found in their method of reproduction. The shape of the frustules, or their markings, will serve for specific, or in some cases for generic characters, but they have no significance that will warrant their use in the erection of higher groups. Absolute shape and size will not serve as definite characters, for a single species between one auxospore stage and the next varies greatly in both these respects. Owing to the peculiar mode of cell division in which each new valve is formed inside the old one, each new frustule is smaller than the parent, hence the size gradually decreases until an auxospore is formed. Schumann[12], out of 470 species found ten in which the length of the largest was five times that of the smallest; twenty-nine in which the largest were from three to four times as long as the smallest, and the rest showing less variation. The variation in form is even as great as the variation in size. This is probably due to the difference in the thickness of the girdle, *i. e.* the part of the valves that overlaps, in different parts of the frustule. *Navicula iridis* Ehr. is a good example of a variable species. Its different forms have been described as species by most writers. In the typical form the valves are elliptical with gracefully curved margins. The first variation from this type has apices cuneate, and a still further deviation shows them acuminate-cuneate; and from this it varies to rostrate or capitate; and a diminution in size goes step by step with this change in form. These forms are represented by *Navicula iridis* Ehr., *N. amphigomphus* Ehr., *N. affinis* Ehr., *N. amphirhynchus* Ehr., and *N. producta* W. Sm. If the overlapping portions of the valves are slightly thicker near the ends than elsewhere, this variation would be the necessary result, for each new valve formed inside an old one would be slightly constricted opposite this thickened place, at first changing the rounded ends to cuneate, and as the narrowing pro-

[12] Pfitzer, l. c., p. 441.

ceeded still further, the cuneate form would become rostrate and a still further narrowing would give a capitate form. So form and size, although they have a certain significance, are not to be considered infallible characters.

The geological records throw no light upon the relationship of the *Bacillariaceæ*, for when this family first appeared, we find the same genera, and largely the same species as in our modern ones. This is probably due to the fact that their ancestors lacked the siliceous covering, and hence were not preserved. Diatoms evolved the same as all other plants until they developed their shells, but these put a stop to their further evolution, at least they show no trace of evolution since their first appearance. So the question arises whether the Diatoms represent the ends of several closely related genetic lines the further development of which was stopped by their siliceous shells, or whether we may trace the development of one form from another. The former supposition is the more probable, for the form of the earliest fossil specimens is identical with that of modern specimens of the same species; and the same genera are found among fossil as among modern Diatoms. If one genus of Diatoms developed from another, we ought to find the more primitive forms in the earlier strata, for there is little chance that their remains would not be preserved had they existed. But instead of this, Diatoms of all forms appear almost simultaneously. We may conclude then that the *Bacillariaceæ* represent the silicified ends of several closely allied genetic lines and that they have not changed in form since they acquired their siliceous covering. The structure of the valves it follows will tell us practically nothing of their relationship.

There are five methods by which auxospores are formed[13]. In the first the protoplasm of one frustule simply escapes from the valves, grows to a certain size, and then invests itself with new valves. In the second, two auxospores, instead of one, are formed in the same way by the dividing of the protoplasm of a single plant. In the third, the protoplasm of two Diatoms unites to form an auxospore. In the fourth, the protoplasm of

[13] Murray, l. c.

two Diatoms emerges from the valves, and placed by side, but without conjugation, forms each an auxospore. In the fifth, two Diatoms divide transversely and the two halves of each conjugate, each half with the corresponding half of the other and thus form two auxospores. Before any truly natural classification can be made the significance of these various modes of producing auxospores must be understood. Whether the sexual or the asexual method is the primitive one must be known, or whether the different methods are so many expedients to overcome the difficulties imposed upon these plants by their siliceous shells. At present our knowledge of the structure and physiology of Diatoms is not sufficient to enable us to construct a perfectly natural system of classification, and until something better is proposed, Petit's may well be adopted, for although it is not wholly natural, it is more so than any which has preceded it.

A NEW FACTOR IN EVOLUTION.

BY J. MARK BALDWIN.

(*Continued from page 451*).

III.

Social Heredity.—There follows also another resource in the matter of development. In all the higher reaches of development we find certain co-operative or "social" processes which directly supplement or add to the individual's private adaptations. In the lower forms it is called gregariousnes, in man sociality, and in the lowest creatures (except plants) there are suggestions of a sort of imitative and responsive action between creatures of the same species and in the same habitat. In all these cases it is evident that other living creatures constitute part of the environment of each, and many neuro-genetic and psycho-genetic accommodations have reference to or involve these other creatures. It is here that the principle of imitation gets tremendous significance; intelligence and vol-

ition, also, later on; and in human affairs it becomes social co-operation. Now it is evident that when young creatures have these imitative, intelligent, or quasi-social tendencies to any extent, they are able to pick up *for themselves*, by imitation, instruction, experience generally, the functions which their parents and other creatures perform in their presence. This then is a form of ontogenetic adaptation; it keeps these creatures alive, and so produces determinate variations in the way explained above. It is, therefore, a special, and from its wide range, an extremely important instance of the general principle of Organic Selection.

But it has a farther value. *It keeps alive a series of functions which either are not yet, or never do become, congenital at all.* It is a means of extra-organic transmission from generation to generation. It is really a form of heredity because (1) *it is a handing down of physical functions*; while it is not physical heredity. It is entitled to be called heredity for the further reason (2) that *it directly influences physical heredity in the way mentioned*, i. e., it keeps alive variations, thus sets the direction of ontogenetic adaptation, thereby influences the direction of the available congenital variations of the next generation, and so determines phylogenetic development. I have accordingly called it "Social Heredity" (ref. 2, chap. xii; ref. 3).

In "Social Heredity," therefore, we have a more or less conservative, progressive, ontogenic atmosphere of which we may make certain remarks as follows:—

(1) *It secures adaptations of individuals all through the animal world.* "Instead of limiting this influence to human life, we have to extend it to all the gregarious animals, to all the creatures that have any ability to imitate, and finally to all animals who have consciousness sufficient to enable them to make adaptations of their own; for such creatures will have children that can do the same, and it is unnecessary to say that the children must inherit what their fathers did by intelligence, when they can do the same things by intelligence" (ref. 6).

(2) *It tends to set the direction of phylogenetic progress* by Organic Selection, Sexual Selection, etc., *i. e.*, it tends not only

to give the young the adaptations which the adults already have, but also *to produce adaptations which depend upon social coöperation; thus variations in the direction of sociality are selected and made determinate.* "When we remember that the permanence of a habit learned by one individual is largely conditioned by the learning of the same habits by others (notably of the opposite sex) in the same environment, we see that an enormous premium must have been put on variations of a social kind—those which brought different individuals into some kind of joint action or coöperation. Wherever this appeared, not only would habits be maintained, but new variations, having all the force of double hereditary tendency, might also be expected" (ref. 3). Why is it, for example, that a race of Mulattoes does not arise faster, and possess our Southern States? Is it not just the social repugnance to black-white marriages? Remove or reverse *this influence of education, imitation, etc.*, and the result *on phylogeny* would show in our faces, and even appear in our fossils when they are dug up long hence by the paleontologist of the succeeding aeons!

(3) *In man it becomes the law of social evolution.* "Weismann and others have shown that the influence of animal intercourse, seen in maternal instruction, imitation, gregarious coöperation, etc., is very important. Wallace dwells upon the actual facts which illustrate the 'imitative factor,' as we may call it, in the personal development of young animals. I have recently argued that Spencer and others are in error in holding that social progress demands use-inheritance; since the socially-acquired actions of a species, notably man, are socially handed down, giving a sort of 'social heredity' which supplements natural heredity" (ref. 4). The social "sport," the genius, is very often the controlling factor in social evolution. He not only sets the direction of future progress, but he may actually lift society at a bound up to a new standard of attainment (ref. 6). "So strong does the case seem for the Social Heredity view in this matter of intellectual and moral progress that I may suggest an hypothesis which may not stand in court, but which I find interesting. May not the rise of social

life be justified from the point of view of a second utility in addition to that of its utility in the struggle for existence as ordinarily understood, the second utility, *i. e.*, of giving to each generation the attainments of the past which natural inheritance is inadequate to transmit. When social life begins, we find the beginning of the artificial selection of the unfit; and this negative principle begins to work directly in the teeth of progress, as many writers on social themes have recently made clear. This being the case, some other resource is necessary besides natural inheritance. On my hypothesis it is found in the common or social standards of attainment which the individual is fitted to grow up to and to which he is compelled to submit. This secures progress in two ways: First, by making the individual learn what the race has learned, thus preventing social retrogression, in any case; and second, by putting a direct premium on variations which are socially available" (ref. 3).

4. The two ways of securing development in determinate directions—the purely extra-organic way of Social Heredity, and the way by which Organic Selection in general (both by social and by other ontogenetic adaptations) secures the fixing of phylogenetic variations, as described above—seem to run parallel. Their conjoint influence is seen most interestingly ingly in the complex instincts (ref. 4, 5). We find in some instincts completely reflex or congenital functions which are accounted for by Organic Selection. In other instincts we find only partial coördinations ready given by heredity, and the creature actually depending upon some conscious resource (imitation, instruction, etc.) to bring the instinct into actual operation. But as we come up in the line of phylogenetic development, both processes may be present *for the same function;* the intelligence of the creature may lead him to do consciously what he also does instinctively. In these cases the additional utility gained by the double performance accounts for the duplication. It has arisen either (1) by the accumulation of congenital variations in creatures which already performed the action (by ontogenetic adaptation and handed it down socially), or (2) the reverse. In the animals, the social

transmission seems to be mainly useful as enabling a species to get instincts slowly in determinate directions, by keeping off the operation of natural selection. Social Heredity is then the lesser factor; it serves Biological Heredity. But in man, the reverse. Social transmission is the important factor, and the congenital equipment of instincts is actually broken up in order to allow the plasticity which the human being's social learning requires him to have. So in all cases both factors are present, but in a sort of inverse ratio to each other. In the words of Preyer, "the more kinds of co-ordinated movement an animal brings into the world, the fewer is he able to learn afterwards." The child is the animal which inherits the smallest number of congenital co-ordinations, but he is the one that learns the greatest number (ref. 2, p. 297).

"It is very probable, as far as the early life of the child may be taken as indicating the factors of evolution, that the main function of consciousness is to enable him to learn things which natural heredity fails to transmit; and with the child the fact that consciousness is the essential means of all his learning is correlated with the other fact that the child is the very creature for which natural heredity gives few independent functions. It is in this field only that I venture to speak with assurance; but the same point of view has been reached by Weismann and others on the purely biological side. The instinctive equipment of the lower animals is replaced by the plasticity for learning by consciousness. So it seems to me that the evidence points to some inverse ratio between the importance of consciousness as factor in development and the need of inheritance of acquired characters as factor in development" (ref. 7).

"Under this general conception we may bring the biological phenomena of infancy, with all their evolutionary significance: the great plasticity of the mammal infant as opposed to the highly developed instinctive equipment of other young; the maternal care, instruction and example during the period of dependence, and the very gradual attainment of the activities of self-maintenance in conditions in which social activities are absolutely essential. All this stock of the development theory is available to confirm this view" (Ref. 3).

But these two influences furnish a double resort against Neo-Lamarkism. And I do not see anything in the way of considering the fact of Organic Selection, from which both these resources spring, as being a sufficient supplement to the principle of natural selection. The relation which it bears to natural selection, however, is a matter of further remark below (V).

"We may say, therefore, that there are two great kinds of influence, each in a sense hereditary; there is *natural heredity* by which variations are congenitally transmitted with original endowment, and there is '*social heredity*' by which functions socially acquired (*i. e.*, imitatively, covering all the conscious acquisitions made through intercourse with other animals) are also socially transmitted. The one is phylogenetic; the other ontogenetic. But these two lines of hereditary influence are not separate nor uninfluential on each other. Congenital variations, on the one hand, are kept alive and made effective by their conscious use for intelligent and imitative adaptations in the life of the individual; and, on the other hand, intelligent and imitative adaptations become congenital by further progress and refinement of variation in the same lines of function as those which their acquisition by the individual called into play. But there is no need in either case to assume the Lamarkian factor" (ref. 4).

"The only hindrance that I see to the child's learning everything that his life in society requires would be just the thing that the advocates of Lamarkism argue for—the inheritance of acquired characters. For such inheritance would tend so to bind up the child's nervous substance in fixed forms that he would have less or possibly no unstable substance left to learn anything with. So, in fact, it is with the animals in which instinct is largely developed; they have no power to learn anything new, just because their nervous systems are not in the mobile condition represented by high consciousness. They have instinct and little else" (ref. 3).

IV.

The Process of Organic Selection.—So far we have been dealing exclusively with facts. By recognizing certain facts we have

reached a view which considers ontogenetic selection an important factor in development. Without prejudicing the statement of fact at all we may enquire into the actual working of the organism is making its organic selections or adaptations. The question is simply this: how does the organism secure, from the multitude of possible ontogenetic changes which it might and does undergo, those which are adaptive? As a matter of fact, all personal growth, all motor acquisitions made by the individual, show that it succeeds in doing this; the further question is, how? Before taking this up, I must repeat with emphasis that the position taken in the foregoing pages, which simply makes the fact of ontogenetic adaptation a factor in development, is not involved in the solution of the further question as to how the adaptations are secured. But from the answer to this latter question we may get further light of the interpretation of the facts themselves. So we come to ask how Organic Selection actually operates in the case of a particular adaptation of a particular creature (ref. 1; ref. 2, chap. vii, xiii; ref. 6, and 7).

I hold that the organism has a way of doing this which is peculiarly its own. The point is elaborated at such great length in the book referred to (ref. 2) that I need not repeat details here. The summary in this journal (ref. 6) may have been seen by its readers. There is a fact of physiology which, taken together with the facts of psychology, serves to indicate the method of the adaptations or accommodations of the individual organism. The general fact is that the organism concentrates it energies upon the locality stimulated, for the continuation of the conditions, movements, stimulations which are vitally beneficial, and for the cessation of the conditions, movements, stimulations, which are vitally depressing and harmful. In the case of beneficial conditions we find a general *increase of movement, an excess discharge of the energies of movement in the channels already open and habitual; and with this, on the psychological side, pleasurable consciousness and attention.* Attention to a member is accompanied by increased vasomotor activity, with higher muscular power, and a *general dynamogenic heightening in that member.* "The thought of a

movement tends to discharge motor energy into the channels as near as may be to those necessary for that movement" (ref. 3). By this organic concentration and excess of movement many combinations and variations are rendered possible, from which the advantageous and adaptive movements may be selected for their utility. These then give renewed pleasure, excite pleasurable associations, and again stimulate the attention, and *by these influences the adaptive movements thus struck are selected and held as permanent acquisitions.* This form of concentration of energy upon stimulated localities, with the resulting renewal by movements of conditions that are pleasure-giving and beneficial, and the subsequent repetitions of the movements, is called the "circular reaction."[4] (ref. 1, 2). It is the selective property which Romanes pointed out as characterizing and differentiating life. It characterizes the responses of the organism, however low in the scale, to all stimulations—even those of a mechanical and chemical (physico-genic) nature. Pfeffer has shown such a determination of energy toward the parts stimulated even in plants. And in the higher animals it finds itself exactly reproduced in the nervous reaction seen in imitation and—through processes of association, substitution, etc.—in all the higher mental acts of intelligence and volition. These are developed phylogenetically as variations whose direction is constantly determined, by this form of adaptation in ontogenesis. If this be true—and the biological facts seem fully to confirm it—this is the adaptive process in all life, and this process is that with which the development of mental life has been associated.

It follows, accordingly, that the three forms of ontogenetic adaptation distinguished above—physico-genetic, neuro-genetic, psycho-genetic—all involve the sort of response on the part of the organism seen in this circular reaction with excess discharge; and we reach one general law of ontogenetic adaptation and of Organic Selection. "The accommodation of an organism to a new stimulation is secured—not by the selection of this stimulation beforehand (nor of the necessary move-

[4] With the opposite (withdrawing, depressive affects) in injurious and painful conditions.

ments)—but by the reinstatement of it by a discharge of the energies of the organism, concentrated as far as may be for the excessive stimulation of the organs (muscles, etc.) most nearly fitted by former habit to get this stimulation again (in which the "stimulation" stands for the condition favorable to adaptation). After several trials the child (for example) gets the adaptation aimed at more and more perfectly, and the accompanying excessive and useless movements fall away. This is the kind of selection that intelligence does in its acquisition of new movements" (ref. 2, p. 179; ref. 6).

Accordingly, *all ontogenetic adaptations are neurogenetic.*[5] The general law of "motor excess" is one of *overproduction;* from movements thus overproduced, adaptations survive; these adaptations set the determinate direction of ontogenesis; and by their survival the same determination of direction is set in phylogenesis also.

The following quotation from an earlier paper (ref. 7) will show some of the bearings of this position:

"That there is some general principle running through all the adaptations of movement which the individual creature makes is indicated by the very unity of the organism itself. The principle of Habit must be recognized in some general way which will allow the organism to do new things without utterly undoing what it has already acquired. This means that old habits must be substantially preserved *in the new functions;* that all new functions must be reached by gradual modifications. And we will all go further and say, I think, that the only way that these modifications can be got at all is through some sort of interaction of the organism with its environment. Now, as soon as we ask how the stimulations of the environment can produce new adaptive movements, we have the answer of Spencer and Bain—an answer directly confirmed, I think, without question, by the study both of the child and of the adult—i. e., by the selection of fit movements from excessively produced movements, that is, from *movement variations.* So granting this, we now have the further question:

[5] Barring, of course, those violent compelling physical influences under the action of which the organism is quite helpless.

How do these movement variations come to be produced *when and where they are needed?*[6] And with it, the question: How does the organism *keep those movements going* which are thus selected, and *suppress* those which are not selected?

"Now these two questions are the ones which the biologists fail to answer. But the force of the facts leads to the hypotheses of "conscious force," "self-development" of Henslow and "directive tendency" of the American school—all aspects of the new Vitalism which just these questions and the facts which they rest upon are now forcing to the front. Have we anything definite, drawn from the study of the individual on the psychological side, to substitute for these confessedly vague biological phrases? Spencer gave an answer in a general way long ago to the *second* of these questions, by saying that in consciousness the function of pleasure and pain is just to keep some actions or movements going and to suppress others.

"But as soon as we enquire more closely into the actual working of pleasure and pain reactions, we find an answer suggested to the *first* question also, *i. e.*, the question as to how the organism comes to make the kind and sort of movements which the environment calls for—the *movement variations when and where they are required.* The pleasure or pain produced by a stimulus—and by a movement also, for the utility of movement is always that it secures stimulation of this sort or that—does not lead to diffused, neutral, and characterless movements, as Spencer and Bain suppose; this is disputed no less by the infant's movements than by the actions of unicellular creatures. There are characteristic differences in vital move-

[6] This is just the question that Weismann seeks to answer (in respect to the supply of variations in forms which the paleontologists require), with his doctrine of 'Germinal Selection' (*Monist*, Jan., 1896). Why are not such applications of the principle of natural selection to variations *in the parts and functions of the single organism* just as reasonable and legitimate as it is to variations in separate organisms? As against "germinal selection," however, I may say, that in the cases in which ontogenetic adaptation sets the direction of survival of phylogenetic variations (as held in this paper) the hypothesis of germinal selection is in so far unnecessary. This view finds the operation of selection *on functions in ontogeny* the means of securing "variations when and where they are wanted;" while Weismann supposes competing germinal units.

ments wherever we find them. Even if Mr. Spencer's undifferentiated protoplasmic movements had existed, natural selection would very soon have put an end to it. There is a characteristic antithesis in vital movements always. Healthy, overflowing, outreaching, expansive, vital effects are associated with pleasure; and the contrary, the withdrawing, depressive, contractive, decreasing, vital effects are associated with pain. This is exactly the state of things which the theory of selection of movements from overproduced movements requires, *i. e.*, that increased vitality, represented by pleasure, should give the excess movements, from which new adaptations are selected; and that decreased vitality represented by pain should do the reverse, *i. e.*, draw off energy and suppress movement.[7]

"If, therefore, we say that here is a type of reaction which all vitality shows, we may give it a general descriptive name, *i. e.*, the "Circular Reaction," in that its significance for evolution is that it is not a random response in movement to all stimulations alike, but that it distinguishes in its very form and amount between stimulations which are vitally good and those which are vitally bad, tending to retain the good stimulations and to draw away from and so suppress the bad. The term 'circular' is used to emphasize the way such a reaction tends to keep itself going, over and over, by reproducing the conditions of its own stimulation. It represents habit, since

[7] It is probable that the origin of this antithesis is to be found in the waxing and waning of the nutritive processes. "We find that if by an organism we mean a thing merely of contractility or irritability, whose round of movements is kept up by some kind of nutritive process supplied by the environment—absorption, chemical action of atmospheric oxygen, etc.—and whose existence is threatened by dangers of contact and what not, the first thing to do is to secure a regular supply to the nutritive processes, and to avoid these contacts. But the organism can do nothing but move, as a whole or in some of its parts. So then if one of such creatures is to be fitter than another to survive, it must be the creature which by its movements secures more nutritive processes and avoids more dangerous contacts. But movements toward the source of stimulation keep hold on the stimulation, and movements away from contacts break the contacts, that is all. Nature selects these organisms; how could she do otherwise? . . . . We only have to suppose, then, that the nutritive growth processes are by natural selection drained off in organic expansions, to get the division in movements which represents this earliest bifurcate adaptation." (Ref. 2, p. 201).

it tends to keep up old movements; but it secures new adaptations, since it provides for the overproduction of movement variations for the operation of selection. This kind of selection, since it requires the direct coöperation of the organism itself, I have called 'Organic Selection.'"

The advantages of this view seem to be somewhat as follows:

1. It gives a method of the individual's adaptations of function which is *one in principle with the law of overproduction and survival now so well established in the case of competing organisms.*

2. It reduces nervous and mental evolution to strictly parallel terms. The intelligent use of phylogenetic variations for functional purposes in the way indicated, puts a premium on variations which can be so used, and thus sets phylogenetic progress *in directions of constantly improved mental endowment.* The circular reaction which is the method of intelligent adaptations is liable to variation in a series of complex ways which represent phylogenetically the development of the mental functions known as memory, imagination, conception, thought, etc. We thus reach a phylogeny of mind which proceeds in the direction set by the ontogeny of mind,[8] just as on the organic side the phylogeny of the organism gets its determinate direction from the organism's ontogenetic adaptations. And since it is the one principle of Organic Selection working by *the same functions* to set the direction of both phylogenies, the physical and the mental, the two developments are not two, but one. Evolution is, therefore, not more biological than psychological (ref. 2, chap. x, xi, and especially pp. 383–388).

3. It secures the relation of structure to function required by the principle of "use and disuse" in ontogeny.

4. The only alternative theory of the adaptations of the individual are those of "pure chance," on the one hand, and a "creative act" of consciousness, or the other hand. Pure chance is refuted by all the facts which show that the organism does not wait for chance, but goes right out and effects new adaptations to its environment. Furthermore, ontogenetic

[8] Prof. C. S. Minot suggests to me that the terms "ontopsychic" and "phylopsychic" might be convenient to mark this distinction.

adaptations are determinate; they proceed in definite progressive lines. A short study of the child will disabuse any man, I think, of the "pure chance" theory. But the other theory which holds that consciousness makes adaptations and changes structures directly by its *fiat,* is contradicted by the psychology of voluntary movement (ref. 4, 6, 7). Consciousness can bring about no movement without having first an adequate experience of that movement to serve on occasion as a stimulus to the innervation of the appropriate motor centers. "This point is no longer subject to dispute; for pathological cases show that unless some adequate idea of a former movement made by the same muscles, or by association some other idea which stands for it, can be brought up in mind the intelligence is helpless. Not only can it not make new movements; it can not even repeat old habitual movements. So we may say that intelligent adaptation does not create coördinations; it only makes functional use of coördinations which were alternatively present already in the creature's equipment. Interpreting this in terms of congenital variations, we may say that the variations which the intelligence uses are alternative possibilities of muscular movement" (ref. 4). So the only possible way that a really new movement can be made is *by making the movements already possible so excessively and with so many varieties of combination, etc., that new adaptations may occur.*

5. The problem seems to me to duplicate the conditions which led Darwin to the principle of natural selection. The alternatives before Darwin were "pure chance" or "special creation." The law of "overproduction with survival of the fittest" came as the solution. So in this case. Let us take an example. Every child has to learn how to write. If he depended upon chance movements of his hands he would never learn how to write. But on the other hand, he can not write simply by willing to do so; he might will forever without effecting a "special creation" of muscular movement. What he actually does is to *use his hand in a great many possible ways as near as he can to the way required;* and from these excessively produced movements, and after excessively varied and numerous trials, he gradually selects and fixes the slight successes made

in the direction of correct writing. It is a long and most laborious accumulation of slight Organic Selections from over-produced movements (ref. for handwriting in detail, 2, chap. v; also 2, pp. 373, ff.).

6. The only resort left to the theory that consciousness is some sort of an *actus purus* is to hold that it *directs* brain energies or selects between possible alternatives of movement; but besides the objection that it is as hard to direct movement as it is to make it (for nothing short of a force could release or direct brain energies), we find nothing of the kind necessary. The attention is what determines the particular movement in developed organisms, and the attention is no longer considered an *actus purus* with no brain process accompanying it. The attention is a function of memories, movements, organic experiences. We do not attend to a thing because we have already selected it, or because the attention selects it; but *we select it because we—consciousness and organism—are attending to it.* "It is clear that this doctrine of selection as applied to muscular movement does away with all necessity for holding that consciousness even directs brain energy. The need of such direction seems to me to be as artificial as Darwin showed the need of special creation to be for the teleological adaptations of the different species. This need done away, in this case of supposed directive agency as in that, the question of the relation of consciousness to the brain becomes a metaphysical one, just as that of teleology in nature became a metaphysical one; and it is not to much profit that science meddles with it. And biological as well as psychological science should be glad that it is so, should it not?" (ref. 6; and on the metaphysical question, ref. 7).

V.

A word on the relation of this principle of Organic Selection to Natural Selection. Natural Selection is too often treated as a positive agency. It is not a positive agency; it is entirely negative. It is simply a statement of what occurs when an organism does not have the qualifications necessary to enable it to survive in given conditions of life; it does not in any way

define positively the qualifications which do enable other organisms to survive. Assuming the principle of Natural Selection in any case, and saying that, according to it, if an organism do not have the necessary qualifications it will be killed off, it still remains in that instance to find what the qualifications are which this organism is to have if it is to be kept alive. So we may say that *the means of survival is always an additional question* to the negative statement of the operation of natural selection.

This latter question, of course, the theory of variations aims to answer. The positive qualifications which the organism has arise as congenital variations of a kind which enable the organism to cope with the conditions of life. This is the positive side of Darwinism, as the principle of Natural Selection is the negative side.

Now it is in relation to the theory of variations, and not in relation to that of natural selection, that Organic Selection has its main force. Organic Selection presents *a new qualification of a positive kind* which enables the organism to meet its environment and cope with it, while natural selection remains exactly what it was, the negative law that if the organism does not succeed in living, then it dies, and as such a qualification on the part of the organism, Organic Selection presents several interesting features.

1. If we hold, as has been argued above, that the method of Organic Selection is always the same (that is, that it has a natural method), being always accomplished by a certain typical sort of nervous process (*i. e.*, being always neuro-genetic), then we may ask whether that form of nervous process—and the consciousness which goes with it—may not be a variation appearing early in the phylogenetic series. I have argued elsewhere (ref. 2, pp. 200 ff. and 208 ff.) that this is the most probable view. Organisms that did not have some form of selective response to what was beneficial, as opposed to what was damaging in the environment, could not have developed very far; and as soon as such a variation did appear it would have immediate preëminence. So we have to say either that selective nervous property, with consciousness, is a variation,

or that it is a fundamental endowment of life and part of its final mystery. "The intelligence holds a remarkable place. It is itself, as we have seen, a congenital variation; but it is also the great agent of the individual's personal adaptation both to the physical and to the social environment" (ref. 4).

"The former (instinct) represents a tendency to brain variation in the direction of fixed connections between certain sense-centers and certain groups of coördinated muscles. This tendency is embodied in the white matter and the lower brain centers. The other (intelligence) represents a tendency to variation in the direction of alternative possibilities of connection of the brain centers with the same or similar coördinated muscular groups. This tendency is embodied in the cortex of the hemispheres" (ref. 4).

2. But however that may be, whether ontogenetic adaptation by selective reaction and consciousness be considered a variation or a final aspect of life, it is a *life-qualification of a very extraordinary kind.* It opens a new sphere for the application of the negative principle of natural selection upon organisms, *i. e.*, with reference to *what they can do*, rather than to what they are; to the new use they make of their congenital functions, rather than to the mere possession of the functions (ref. 2, pp. 202 f.). A premium is set on congenital plasticity and adaptability of function rather than on congenital fixity of function; and this adaptability reaches its highest in the intelligence.

3. It opens another field also for the operation of natural selection—still viewed as a negative principle—through the survival of particular overproduced and modified reactions of the organism, by which the determination of the organism's own growth and life-history is secured. If the young chick imitated the old duck instead of the old hen, it would perish; it can only learn those new things which its present equipment will permit—not swimming. So the chick's own possible actions and adaptations in ontogeny have to be selected. We have seen how it may be done by a certain competition of functions with survival of the fit. But this is an application of natural selection. I do not see how Henslow, for example, can get the so-called "self-adaptations"—apart from "special

creation"—which justify an attack on natural selection. Even plants must grow in determinate or "select" directions in order to live.

4. So we may say, finally, that Organic Selection, while itself probably a congenital variation (or original endowment) works to secure new qualifications for the creature's survival; and its very working proceeds by securing a new application of the principle of natural selection to the possible modifications which the organism is capable of undergoing. Romanes says: "it is impossible that heredity can have provided in advance for innovations upon or alterations in its own machinery during the lifetime of a particular individual." To this we are obliged to reply in summing up—as I have done before (ref. 2, p. 220)—we reach "just the state of things which Romanes declares impossible—heredity providing for the modification of its own machinery. Heredity not only leaves the future free for modifications, it also provides a method of life in the operation of which modifications are bound to come."

VI.

The Matter of Terminology.—I anticipate criticism from the fact that several new terms have been used in this paper. Indeed one or two of these terms have already been criticised. I think, however, that novelty in terms is better than ambiguity in meanings. And in each case the new term is intended to mark off a real meaning which no current term seems to express. Taking these terms in turn and attempting to define them, as I have used them, it will be seen whether in each case the special term is justified; if not, I shall be only two glad to abandon it.

Organic Selection.—The process of ontogenetic adaptation considered as keeping single organisms alive and so securing determinate lines of variation in subsequent generations. Organic Selection is, therefore, a general principle of development which is a direct substitute for the Lamarkian factor in most, if not in all instances. If it is really a new factor, then it deserves a new name, however contracted its sphere of application may finally turn out to be. The use of the word

"Organic" in the phrase was suggested from the fact that the organism itself coöperates in the formation of the adaptations which are effected, and also from the fact that, in the results, the organism is itself selected; since those organisms which do not secure the adaptations fall by the principle of natural selection. And the word "Selection" used in the phrase is appropriate for just the same two reasons.

Social Heredity.—The acquisition of functions from the social environment, also considered as a method of determining phylogenetic variations. It is a form of Organic Selection but it deserves a special name because of its special way of operation. It is really heredity, since it influences the direction of phylogenetic variation by keeping socially adaptive creatures alive while others which do not adapt themselves in this way are cut off. It is also heredity since it is a continuous influence from generation to generation. Animals may be kept alive let us say in a given environment by social coöperation only; these transmit this social type of variation to posterity; *thus social adaptation sets the direction of physical phylogeny and physical heredity is determined in part by this factor.* Furthermore the process is all the while, from generation to generation, aided by the continuous chain of extra-organic or purely social transmissions. Here are adequate reasons for marking off this influence with a name.

The other terms I do not care so much about. "Physico-genetic," "neuro-genetic," "psycho-genetic," and their correlatives in "genic," seem to me to be convenient terms to mark distinctions which would involve long sentences without them, besides being self-explanatory. The phrase "circular reaction" has now been welcomed as appropriate by psychologists. "Accommodation" is also current among psychologists as meaning single functional adaptations, especially on the part of consciousness; the biological word "adaptation" refers more, perhaps, to racial or general functions. As between them, however, it does not much matter.[9]

[9] I have already noted in print (ref. 4 and 6) that Prof. Lloyd Morgan and Prof. H. F. Osborn have reached conclusions similar to my main one on Organic Selection. I do not know whether they approve of this name for the "factor;" but as I suggested it in the first edition of my book (April, 1895) and used it earlier, I venture to hope that it may be approved by the biologisst.

THE PATH OF THE WATER CURRENT IN CUCUMBER PLANTS.

By Erwin F. Smith.

(*Continued from page 457*).

3. Downward Movement of One Per Cent Eosine Water in Cut Stems Not Severed From Their Roots.

(No. 17). This was a young vine, 120 centimeters long, full of blossoms and young fruits and very thrifty; it bore about 24 leaves, the largest five averaging 20 cm. in breadth. March 23, 3:20 P. M. The terminal 12 cm. of the stem was cut away under water and the stump bent over and plunged into 1 per cent eosine water. The sun shone hot and the air of the house was rather dry. 4:20 p. m. No trace of stain in the veins of any of the leaves. March 25, noon. It is now over 44 hours since the cut stem was plunged into the eosine water and judging from the quantity remaining in the bottle no measurable volume has gone down the stem. The external appearance, proceeding from above downwards, is as follows: The first internode (the one in the eosine and just above it) is badly shriveled and diffusely stained. The first leaf (9.5 cm. from the cut end) is not quite as turgid as the rest, and its veins show a faint stain. The second internode (10 cm.) is pinkish green and in the grooves of the stem pink, especially toward the upper end, seeming to indicate that most of the stain has passed through the inner ring of bundles. The veins of the second leaf are also distinctly but faintly pink. The petiole of this leaf is 9 cm. long and its blade 12 cm. broad, and the same pale stain is to be seen in all of the veins. Further down there is no external evidence of stain. The downward movement of the stain has, therefore, been very slight. 1:30 p. m. A long tendril from the second node shows a faint internal stain outward for a distance of 10 cm. On cutting, this is seen to be due to stain lodged in the bundles, while at its base there is also a little diffuse stain. The stain now shows

through the interior of the third node which is 9 cm. long. 1:35 p. m. The stem was now cut for examination. The surface of the eosine water in the bottle has not lowered perceptibly. The diffuse stain in the first internode includes everything; the tissues are shriveled and seem to be dead. In the petiole of the first leaf there is a faint stain of the xylem part of each bundle; no diffuse stain into the phloem or any of the tissues outside of the bundle. At the base of the second internode (9 cm farther from the cut stem) the entire xylem of each bundle shows a pale red stain and this has diffused out from three bundles into the surrounding tissues. The second petiole, cut in the middle, shows a faint pink stain, best seen under the lens. It is sharply restricted to the bundles, but occurs in each one and includes the whole of the xylem. At the base of the third internode (9 cm. farther away from the fluid) the stain is fainter and is restricted to the xylem. It is in all of the bundles and is sharper (?) in the spirals of some. Apex of third petiole (down) shows faintest trace of color in 3 bundles, only to be seen under the lens. Color more distinct in the middle part but very faint. Base of fourth internode (9 cm. further from the eosine) there is a very faint stain sharply restricted to the xylem of 6 bundles, all of which is stained. Middle of next lower petiole shows barest trace of stain in two bundles, not visible without a lens. Stain visible in ten bundles of a small fruit from the same node. The base of the next internede (10 cm. further down) shows not a trace of stain. Five cm. farther up, no stain. Additional 3 cm. up, i. e., close under the node, there is a faint stain in the xylem of three bundles and this is not restricted to the spirals. One-half centimeter closer to the node the color is faint and is still restricted to the three bundles.

The stain seems to have travelled in all of the lignified walls, and it appears clear that the spirals did not carry it more than the other woody parts of the bundle. The movement of the eosine water down these stems, contrary to the water current, was scarcely more abundant than the upward movement past the gelatine plugs. Judging from this, the very slow downward movement of the stain apparently follows another

law than that governing the rapid upward movement of the transpiration water, i. e., that of surface tension or capillarity.

(No. 19). This was a large old vine, nearly destitute of leaves, the only large one being 8 centimeters below the cut stem. March 23, 4:06 p. m. The tip of this stem was cut under water and immediately transferred to 1 per cent eosine water. 4:15 p. m. No stain in the veins of the first leaf, 8 cm. from the cut. March 25, 12:45 p. m. The leaf, 8 cm. from the cut end, is flabby and its veins show a very decided stain. Farther down there is no stain visible externally. The stem was now removed from the fluid and cut open for examination. At 5 cm. down there was a diffuse stain involving the whole stem, but it was not dense and the bundles were not deeper stained than farther down the stem. At 10 cm. the sieve tube tissue was stained as well as the xylem and there was also a slight diffuse stain into the parenchyma, but the general tone of the stem remained green. At 20 cm. from the cut tip one of the 9 bundles (outer ring) showed no stain. No stain outside of the bundles. At 40 cm. from the cut all of the bundles showed the stain but in one (outer ring) it was much fainter than in the rest. The color was a decided pale red, including the whole of the xylem but not extending to any other part of the stem. At 80 cm. down, the stain was restricted to 4 bundles (the whole of the xylem part) and was barely discernable. At 85 cm. there was still a trace in these bundles—stain in the whole of the xylem and not brighter in the spirals. At 90 centimeters, and farther down, the stain was wholly absent.

This also proved a very instructive stem. The fact that at remote distances the stain was not restricted to the spiral vessels of the stem but tinged the whole xylem equally (the lignified walls) is very striking and decidedly different from the results obtained by passing the stain up the stem, in which case the spirals are stained ahead of the pitted vessels and are clearly seen to be the carriers of the eosine. In this case that portion of the stem in the fluid was not shriveled, probably because it was old and woody.

4. Movement of Water Through Boiled Stems Not Severed From the Plant.

(No. 11). A fine thrifty vine, 180 centimeters long, bearing 18 large leaves and half as many more small ones. The largest leaves have a spread of 17 to 19 centimeters. March 21, 4:00 p. m. About 35 cm. from the earth, the bright green stem was bent over and immersed for a distance of 20 cm. in hot water. An attempt was made to boil this water but the heat under the basin was not sufficient, although ample to kill the stem. 4:30 p. m. The temperature of the water during the last half hour has risen from 71° C. to 75° C. There is no change in the color of the immersed part of the stem, nor any change in the foliage above, but the effect of the hot water is already noticeable in the very decided shrinkage of the immersed stem. It has shrunk in diameter nearly one-half. 4:50 p. m. During the last 20 minutes the temperature of the water has risen only one degree. This was now poured out and water at 89° C. substituted. In pouring, the temperature fell to 85° C. In this hotter water the stem quickly became paler green. 4:58 p. m. Temp. of water 80° C. The immersed part of the stem has now shrunk to one-third of its normal diameter, and this shrinkage has extended both up and down, for a short distance out of the water (a few centimeters). 5:15 p. m. Temp. now down to 76° C. Stem taken out. Except the apex of one leaf, 15 cm. up, the foliage did not become flabby. Below the boiled part is a small branch with half a dozen leaves, sufficient to carry the roots. March 22, 11 a. m. The boiled part of the stem, which is now dry and greenish-brown, was wrapped in many folds of rubber cloth. The foliage of this vine shows no wilt, except parts of 5 small leaves, which were near the boiled part and may have been injured by the heat of the lamp. It is windy and sunny and the air of the house is rather dry so that transpiration is active. Temperature in shade, 1 foot above the bench, 26° C. Noon. A check vine (cut off at base, yesterday p. m.) has wilted and shriveled. Temperature three feet above the bench, among the leaves, 30° C. 1:20 p. m. No change. What is

especially surprising is that the tender terminal leaves show no signs of wilt. 4:15 p. m. This vine has stood up remarkably to-day. The transpiration demands have been large and there has been no wilt—not a trace—that mentioned as occurring on a few of the small basal leaves being evidently due to imperfect protection from the heat of the lamp when the stem was boiled. March 23, 11 a. m. Sunny and hot; some wind; air of the house rather dry, and transpiration large. No wilt of the foliage except the margins and tips of the blades of three big leaves midway up the stem. These are slowly drying out. 12:30 p. m. The greater part of the foliage on this vine is still turgid and normal in appearance. The tips and margins of the three leaves above mentioned are crisp, but this injury involves only a small part of each leaf. Transpiration active. Temp. in sun 30° C. Dry bulb 26.5° C.; wet bulb 22° C. 3:00 p. m. Slight, if any, change. Nearly all of the leaves are turgid and entirely normal in appearance, including all at the top of the vine. 4:20 p. m. No change since the last record. The vine stands up well. Temp. now 24° C. Active transpiration all day. March 25, 1:15 p. m. The vine stands up well. Nearly all of it is perfectly healthy, including the tender upper part, but portions of the lower leaves already mentioned are slowly drying out and in a very interesting manner, i. e., after the fashion of the California vine disease, the larger veins and their branches and a little of the adjacent parenchyma remaining green, even dark green, while the parenchymatic areas between the veins, especially at the apex of the blades and on the margins, are becoming first yellow and then a dead brown. 5:30 p. m. Vine stands up beautifully. It is four days since the stem was killed by the hot water. March 26, 2:45 p. m. A great change for the worse since yesterday. All of the foliage has now wilted (as yet only the blades) and the large leaves midway down as well as the smaller lower ones are rapidly drying out. March 27, 1:20 p. m. All of the leaves are now crisp, except a few very small flabby ones which are in the vicinity of a half grown fruit from which they are drawing water. The stem is still turgid but some of the petioles begin to droop.

The leaves below the boiled part are still healthy. March 28, 1:30 p. m. The stem and the petioles are still green but the latter are becoming more and more flabby, most of them at the top of the vine having lost all of their turgor.

This vine was able to draw all the transpiration water necessary to supply a large leaf surface (more than 3.000 sq. cm.) through about 25 centimeters of dead stem for a period of four days, during a part of which time the transpiration was very active. All of this water must have passed up through the bundles, since all the outer parts were dead and dry and shriveled down onto the bundles, the vessels of which preserved their shape unaltered as shown by subsequent examination.

(No. 13). This vine was 130 centimeters long. It bore six small leaves and 12 large ones, the best averaging 17 cm. in breadth. March 22, 1:02 p. m. The stem was bent over near the earth and inserted for a distance of 18 centimeters into water at 90° C. In two minutes the temperature rose to 95° C. 1:07 p. m. Water simmering; temp. 97° C. Boiled part not yet noticeably smaller. 1:10 p. m. Stem shows shrinkage and change of color. 1:15 p. m. Slight loss of turgidity in most of the leaves. 1:20 p. m. A marked shrinkage of the diameter of the stem is now first visible. The flabbiness of the foliage is increasing rapidly, every leaf is affected. 1:27 p. m. Water has remained at 97° since last record. Stem taken out because of the marked wilt of the foliage. This wilt appears to be due to the transpiration of hot water. The wilt is too sudden and decided to be due to anything else. The stem has not only shriveled in the water but also for a distance of 10 cm. up and 5 cm. below, making a total of 33 cm. of dead stem. Sun hot; earth and air of house rather dry; transpiration active. Such an experiment were better tried when the air is nearly saturated and transpiration slight. 1:45 p. m. Stem wrapped in many folds of rubber cloth. Roughly estimated it has shrunk to about one-third its normal diameter. The leaves seem to be recovering their turgor.

2:00 p. m. The lowest leaves are still flaccid but the upper ones have fully regained their turgor. 3:45 p. m. The lower leaves have now also regained their turgor. Its loss was

clearly due to the transpiration of hot water. (Subsequent experiments showed that it is very easy to push this wilting beyond the power of the plant to recover). 4:15 p. m. The plant stands up well. There is no trace of wilt. March 23, 11 a. m. No sign of wilt. Noon. The lowest five leaves show distinct signs of wilt at the tip of the blade. None of the upper leaves show any trace of it. 12:25 p. m. The wilting is worse but is still confined to the lower leaves. It is very decided on the lowest one which is exposed to the bright sun. The tender apical leaves are turgid, as well as those in the mid part of the stem. 1:20 p. m. The leaf next to the lowest one begins to crisp. 3:00 p. m. Blade of lowest leaf but one is now crisp, and the blades of the other four are drying out at the apex and on the margins and between the larger veins. 4:30 p. m. No change. The bulk of the foliage stands up well, including all of the upper leaves March 25, 1:20 p. m. The lower leaves of this plant are dried out to a greater extent than are those of No. 11, but the major part of the foliage is normal and the tips of both vines are noticeably turgid. The drying out of the parenchyma between the veins is also to be seen in the affected leaves of this vine, the larger veins and a narrow border of the leaf parenchyma remaining a bright green. 5:40 p. m. The vine stands up well. It is three days and four hours since the stem was boiled. March 26, 3:00 p. m. The vine begins to show symptoms of collapsing. All of the petioles are turgid, but the blade of the lowest leaf is nearly dry, that of the next up is wholly dry; those of the next three above are crisp at the apex and on the margins (one-fifth to one-third the surface); the three next up show a trace of drying on their margins, and in all the rest there is a faint suggestion of loss of turgor. March 27, 2:00 p. m. All of the leaves on this vine are now crisp-dry except three at the top which are flabby. The stem and the petioles are still turgid. March 28, 1:30 p. m. The upper three leaves are still flabby, and all of the petioles are still rigid except the tips of some of the lower ones which begin to droop.

This vine gives results confirmatory of the preceding. For more than three days the plant was able to draw all of the

water necessary for its use through 33 cm. of dead stem. Probably if air could be prevented from gradually passing through the shriveled stem into these water carrying vessels and interfering with the normal condition of things the plant might continue to draw its water through a dead stem almost indefinitely.[1]

5. The Result of Parasitic Plugging of the Vessels.

From these experiments and those upon the cucumber wilt, which I have published elsewhere, it follows that the downward path of *Bacillus tracheiphilus* from the inoculated leaf blade into the stem of the cucumber (for an account of this disease see *Centr. f. Bakt. u. Par. Allg.* I, No. 9–10, 1895) is exactly that made use of by the ascending water current, just as I stated it to be at the Brooklyn meeting of the A. A. A. S., and the general wilt of the foliage may be explained, first, by a functional disturbance, due to the more or less complete clogging of the lumina of the spiral vessels with countless millions of these bacteria which thrive in the alkaline fluid of the vessels, and, second, by a structural disturbance, due to the breaking down (dissolving) of the walls of these spirals and the flooding out and subsequent growth of the bacteria in the surrounding parenchyma and in the pitted vessels, accompanied, of course, by the more or less free entrance of air into the spirals. It is probable, although not enough examinations have yet been made to render this certain, that no leaf wilts from secondary infection until the water carrying spirals in its petiole have become clogged by the bacillus, i. e., that the wilt of the leaf is not induced by the partial clogging of the vessels farther down in the stem. This is the more likely, first, from the fact that there is always a progressive wilt, leaf after leaf, beginning with the ones nearest the point of infection and moving both ways therefrom, and, second, from the fact that very rarely are all of the pitted vessels filled, so that water lifted up from the roots has always the opportunity to

[1] Those who wish to follow these subjects may consult the above mentioned work by Strasburger, pp. 510–936, where many interesting experiments are detailed.

pass around the clog in the spirals by way of the unfilled pitted vessels and to enter the spirals once more farther up. Were this not so, i. e., were pitted vessels filled as readily, as quickly, and as fully as the spirals, we should have not the gradual wilt of leaf after leaf up and down the stem, but the sudden collapse of all the leaves beyond the original point of attack. This is exactly what does happen in watermelon vines attacked by *Fusarium niveum*, (for a brief account of this parasite see *Proc. Am. Asso. Adv. Sci.*, Vol. 43, 1894, p. 289, and *Ibid*, Vol. 44, 1895, p.) where the pitted vessels appear to fill with the fungus as soon, if not sooner, than the spirals.

These two diseases of cucurbits are very interesting from a physiological standpoint, and both parasites lend themselves readily to infection experiments, their slightly different behavior being, perhaps, accounted for by the fact that the fungus is strictly ærobic, while the bacillus is facultative anærobic. Whatever be thought of butter or gelatine, it certainly cannot be maintained that the mere presence of these parasites in the lumina of the vessels destroys the carrying capacity of the uninjured walls, and yet they act quite as effectually as gelatine, paraffin, or cocoa butter plugs, causing, when they fill the vessels only incompletely, a flabbiness of the foliage, which is proportionate to the extent of the plugging and to the activity of the transpiration, and which may give place to complete turgor in periods when the transpiration is small (night, early morning, or damp days), and producing, when they completely fill the lumina of the vessels, an entire collapse of the foliage, from which there is no recovery. In case of the cucumber this collapse takes place as soon as the spiral vessels leading into any petiole are filled by the bacillus.

EDITOR'S TABLE.

—Professors in the scientific departments of our schools should exercise their influence to prevent the spoliation of nature that is going on at so rapid a rate in our country. We do not especially refer at present to forest fires which involve so much financial loss that our state and general governments are moving in the direction of their prevention. In passing, however, we must refer to the railroad companies as delinquents in this matter, and insist that heavy fines be imposed on them in all cases where fires can be shown to have originated from locomotives. We counted from the car windows of a train not long since, twelve distinct fires burning near the track in the space of a few miles, in a forest covered region not far from Philadelphia, and no one appeared to pay any attention to them.

We wish, however, to refer to the destruction wrought near our cities by the uprooting of plants and the breaking off of branches for purposes of decoration of public and private houses. Within reasonable bounds the vegetable world furnishes material for such decoration, but the practice is carried beyond the rich resources of nature to meet. Our woods are being rapidly stripped of ornamental plants for miles all round our large cities. In many regions the *Epigœa repens* is completely destroyed, and the blooms of the dogwood and kalmia no longer appear. Lycopodia are uprooted over large tracts, and must now be brought from considerable distances. Some of the ruin is wrought for church decoration, and the girl-graduate is responsible for more of it. Teachers of the natural sciences can teach their hearers that this cannot go on forever. Especially can they point out that botanical classes should not gather arm-loads of orchids of fastidious habits if they do not wish to see the localities destroyed or the species well nigh exterminated.

The authorities in charge of our public parks might, in some places, profitably change their point of view. A park should not consist principally of graded paths lined with stone curbs or walls, separated by tracts of close shorn grass. Shrubberies of nature's planting should remain, and the vines with which nature festoons the forest should not be cut down. No harm is done if there are places where rabbits may hide, and wild birds may nest. Even an owl or two might be permitted to keep down so far as he or she can, the English Sparrow nuisance. In fact, a park is not necessarily a place from which nature is

excluded. The perpetual clearing of undergrowth means also the ultimate destruction of forest, as the natural succession is thus prevented.

As an offset to this public and private vandalism, we have near our cities a goodly number of citizens who preserve more or less of nature in their private parks. It will be to these to whom we must look to replenish our stock of native shrubs and herbs, if the vandal continues to have full swing elsewhere.

THE forty-fifth meeting of the American Association for the Advancement of Science to commence at Buffalo, N. Y., on August 22d, will be characterized by one feature which is deemed by the society an improvement over previous meetings. No excursions will be made during the working hours of the day during the session, only those occupying evening hours being acceptable. At the close of the meeting the field for such diversions will be clear. The geological excursions have been so arranged as not to conflict with the meetings; and the six scientific societies, which meet about the same time, it is hoped will contribute to the importance of the general gathering. It is anticipated that these arrangements will arrest the tendency to dissipation of energy which has been apparent during the last few years. If the habit of many of the embryologists to absent themselves could be overcome, the full force of the Association would be represented. It is expected that a number of evening lectures will present to the public the latest results of research in America.

RECENT LITERATURE.

Surface Colors :—The object of the little book on this subject[1] by Dr. Walter, of Hamburg is apparently to furnish zoologists, mineralogists, and chemists with an accurate explanation of certain color phenomena which are not as yet universally understood, and which are incompletely treated even in the best text-books on Physics. The keynote of the whole book is given in a single sentence of the introductory chapter. " The intensity of the light reflected from any body may be calculated by Fresnel's ordinary formulæ for colorless substances, in the case of those rays which are slightly or not at all absorbed by the

[1] Die Oberflächen-oder Schillerfarben, von Dr. B. Walter, pp. VIII + 122, Braunschweig, F. Vieweg und Sohn, 1895.

body in question; but for wave-lengths which are strongly absorbed by the given substance, Cauchy's formulæ for the intensity of metallic reflection should be used." It appears from these formulæ that the intensity of the reflected light depends on the index of refraction and on the coëfficient of absorption of the substance presenting the reflecting surface. Since both these factors are different for light of different colors, it is shown that white light must be reflected with some of its "components" relatively weaker than others, *i. e.*, no longer in the proper proportion to give the sensation of white light. The application to the colors seen in the mineral kingdom is illustrated by the example of magnesium cyanplatinite, $Mg\,Pt\,(CN)_4$, where,—as is true of most crystals,—the index of refraction and the coëfficient of absorption vary with the direction in which the light vibrates, as well as with the wave-length of the light. The extent to which true surface color is observable on minerals is not indicated, though the *possibility* of a very wide application is clearly shown.

In the appendices, certain mathematical aspects of the subject are treated in a manner suited to the requirements of physicists.—A. C. G.

The Whence and Whither of Man.[2]—This book comprises a series of lectures dilivered at Union Theological Seminary, with some additional matter. The author discusses the doctrine of Evolution from the standpoint of a theologian. He endeavors to show that the great law of animal and human development as revealed in the sequence of physical and mental development is that those species survive which are best conformed to their environment; that this law holds good in the development of the rational, the dominant faculty in man; and finally, to become higher man he must develop a moral-nature by attaining a knowledge of himself as a moral agent, and while not disregarding the body, he must subordinate its appetites to the higher motives furnished by right and duty. It is in following this line of thought that the author hopes for a definite answer as to the future destiny of man.

The closing chapter deals with the present aspects of the theory of evolution. He here compares the various hypotheses of evolution and considers their merits. He judiciously selects the good elements of all of them, concluding that "each theory contains important truth." He concludes that Nägeli's view of "initial tendencies" is too often undervalued. "My own conviction is steadily strengthening that without

[2] The Whence and Whither of Man. By John M. Tyler, New York. 1896, Charles Scribner's Sons, Publishers.

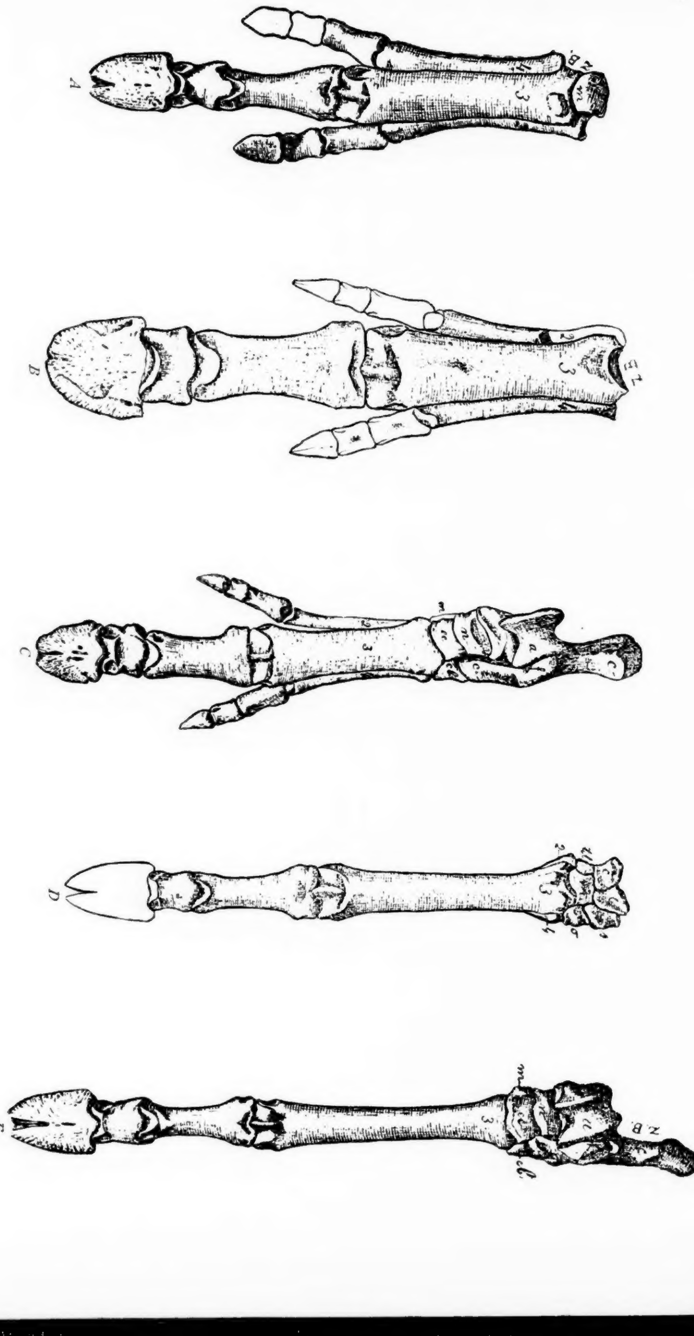
some such original tendency or aim, evolution would never have reached it present culmination in man." He quotes Boveri that "there is too much intelligence in nature for any purely mechanical theory to be possible." It is curious that these authors do not perceive that the sensation of protoplasm, (consciousness), furnishes the basis for the exhibition of the intelligence which they observe, and which has itself undergone evolution coincidentally with the organism. Both orthodox and heterodox evolutionists (theologically speaking) seem equally slow to adopt this view.

Prof. Tyler's book is eminently moderate and reasonable, and will introduce evolution to a large class of readers in an agreeable form.

Cope on the Factors of Organic Evolution.[3]—This book is divided into three parts: I, The nature of variation; II, The causes of variation; III, The inheritance of variation. In the first part it is endeavored to show that variation is not promiscuous or multifarious, but pursues direct courses towards definite ends. This is done by presenting the variations of existing species as to color and structure, and by an examination of the series presented by the forms of vertebrate life in past geologic ages. The latter presentation is a general phylogeny of the vertebrata, with special sections on that of the horse and that of man. The second part is divided into chapters which deal with the physical energies as causes of variation, and the effects of molar motion as seen in variation. These methods of evolution are termed respectively physiogenesis and kinetogenesis. Especial attention is given to kinetogenesis in connection with the phylogeny of vertebrates, since it is in these two fields that most of the original work of the author has been done. The author has demonstrated that the primary cause which has moulded the vertebrate skeleton is molar motion. In the third part, the inheritance of the characters so produced is shown to be the rule, thus demonstrating the inheritance of acquired characters. Theories of inheritance are discussed, and that one which asserts the transmission of energies to the germ plasma is defended. These energies are believed to be the results of a composition between inherited and acquired energies, the whole of them being referred to a class distinct from the inorganic energies, which he has named Bathmic. The last chapter in this part is devoted to a consideration of the relation of consciousness to movements, and hence as a cause

[3] The Primary Factors of Organic Evolution, by E. D. Cope, Professor of Zoology and Comparative Anatomy in the University of Pennsylvania. Chicago: Open Court Pub. Co., Feb., 1896, $2.00.

PLATE X.



Feet of Proterotheriidae from Ameghino. A, fore foot of *Proterotherium cavum* Amegh. B-C, Fore and hind feet of *Diadiaphorus majusculus* Amegh. D-E, Fore and hind feet of *Thoatherium crepidatum* Amegh.

of progressive evolution. The author holds that sensation is a cause of effects which would not appear in its absence, and that its presence conditions progressive evolution. The author holds this to be proven not only by the direct effect of consciousness as observed, but also on the other ground that there is no sufficiency in the inorganic and unconscious organic energies to effect progressive evolution. This is because the well-known tendency of the latter is to the integration of matter and the dissipation of energy, which leads always away from vital phenomena. The author believes the entire vegetable kingdom to be degenerate, its vitality being the expression of automatic energy which derived its self-sustaining character from ancestors endowed with sensation which occupied a position between animals and plants. The Mycetozoa he believes to be existing near relatives of these types.

The book is illustrated by 120 plates and cuts. One of these illustrative of homoplassy, we extract from the chapter on kinetogenesis, with the following explanatory remarks:

"Before reviewing the subject, I cite what is the most remarkable example of homoplassy in the Mammalia which has yet come to the knowledge of paleontologists. Ameghino has discovered in the cenozoic formations of Argentina a group of Ungulata which he calls the Litopterna, and which I regard as a suborder of the Taxeopoda, allied to the Condylarthra (p. 128). Ameghino placed the group under the Perissodactyla, but the tarsus and carpus are of a totally different character, and indicate an origin from the Condylarthra quite independent of that division. The carpal and tarsal bones are in linear series, or if they may overlap, it is in a direction the opposite of that which characterizes the order Diplarthra (=Perissodactyla and Artiodactyla). But the Litopterna present a most remarkable parallelism to the Perissodactyla in the characters of both the feet and the dentition. No genus is known as yet which possesses more than three toes before and behind, and these are of equal length (Macrauchenia Owen). In this genus the teeth are not primitive, but are much modified. The most primitive dentition is seen in the genus Proterotherium (Ameghino) where the superior molars are tritubercular, as in many Condylanthra. In this genus (Pl. X, fig. A) there are three toes, but the lateral ones are reduced, about as in the equine genus Anchitherium (p. 148). In the next genus, Diadiaphorus Amegh., the superior molars are quadritubercular and crested, while the lateral toes are reduced still more, being quite rudimental (figs. B C), as in the equine genera Hippotherium and Prothippus. The superior molars have not progressed so far as in these genera, but are not very different from those of

Anchitherium. In the third and last type (Thoatherium Amegh.) the lateral digits have disappeared from both fore and hind feet (figs. C D), so that the condition is that of the genus Equus (fig. 81), but the splints in the *Thoatherium crepidatum* Amegh. are even more reduced in the known species of horse. The superior molars have not assumed the pattern of the genus Equus, but resemble rather those of Macrauchenia, and could have been easily derived from those of Diadiaphorus.

Here we have a serial reduction of the lateral digits and their connections with the leg, and increase in the proportions of the middle digit and corresponding increases in the proximal connections, exactly similar to that which took place in the horse line, in a different order of Mammalia."

The publishers have done their work well, and are especially to be commended for having made the book of a convenient size to be carried in the pocket or satchel.

The Child and Childhood in Folk-Thought.—(The Child in Primitive Culture); by A. F. Chamberlain; New York, Macmillan & Co., and London, 1896. Pp. x and 464; with bibliography and three indexes; price $3.

Dr. Chamberlain's work is not, as its chief title might lead one to suppose, a mere collection of folk-lore about the child. It is rather an attempt by this means to study the position of the child in primitive society. The author has brought together a great mass of material from every hand, and arranged it systematically under appropriate headings; as a result we find every phase and aspect of childhood represented in his book.

The opening chapters, on the Lore of Motherhood and Fatherhood, have in some places only a remote bearing upon the main topic, but they may be regarded in the light of a general introduction. Following these are a number of chapters which aim to show the attitude of society toward the child; folk-lore on the soul of the child, legends connecting children with animals or plants, stock answers of the adult to the child's questions, superstitions concerning children, etc., together with stories of education and training among uncultured races. A large part of the work deals with the influence of the child upon society—the effect of child-language in modifying adult language; the child's position in many tribes as oracle, judge, physician, or priest, etc. The final chapters are a selection of popular proverbs and sayings bearing upon childhood, from the literature of various races, cultured as well as

uncultured. The bibliography at the end is thorough, if not exhaustive; it consists of over 550 titles, covering the entire field.

The author claims no originality of investigation; but he has culled his material from a host of authorities, and his selections are well made. He has no conclusions to draw; he simply presents the material as data, with a view to a complete survey of the subject. The chief criticism that can be made upon his method is that it frequently leads to a curious intermingling of fables and traditions with actual race customs. Thus in the chapter on the Children's Food is described (p. 150) the practice which holds among several tribes of placing food on the grave of a dead child, to refresh its soul on the way to the spirit-land, and almost immediately after follows the legend of how the infant Hercules obtained immortality. The book is exceedingly interesting; it treats its subject as thoroughly as the breadth of the task together with the limits of the volume permit; and it is wonderfully conducive to further reading.—H. C. Warren.

Stockham on the Ethics of Marriage.[1]—This book is written with the view of securing an excellent object, the increase of the happiness of marriage. As the authoress is an M. D., and as she treats the subject at the outset with a seeming respect for scientific truth, we anticipated something valuable from her point of view. But we are compelled to say that the grains of truth are overlaid with such a quantity of error, rhapsody and sheer silliness, that we can only recommend the book as a study in feminine psychology. That there is one element of common sense running through it we are glad to admit. The authoress sees nothing degrading or indecent in the sexual relation. For this we must praise her; but it was surely not necessary for her to apologize for her good sense, by pages on pages of religious rhapsody. The gist of her method of promoting marital happiness is that sexual intimacy may take place without completing the act. This proposition is as old as the rational faculty of man; but, as rationality is usually less directed to sexual subjects than to any other, it is quite possible that her advice on this point may do some good. There are some amusing passages. Fearing to appear to fall into the Charybdis of "hedonism" she runs high and dry on Scylla, as follows: "Before and during the time some devotional exercises may be participated in, or there may be a formation of consecration of an uplifting character in which both unite!"

[1] Karezza; Ethics of Marriage, by Alice B. Stockham, M. D., Chicago. A. B. Stockham & Co.

The authoress labors under several physiological errors, which should be pointed out. She thinks in common with the ignorant classes generally, that the orgasm is concerned in impregnation, which is well known not to be the case. She also asserts that the secretion of the testis is produced at the time it is needed for use, an idea promulgated several years ago in a silly book called Diana. This is also untrue; its elaboration requires some days, and when the gland is full the secretion makes its presence known and demands expulsion. The present book should have stated also, that the practice she recommends, which she calls "Karezza," is a most potent stimulant of the secretion in question, and does in some men produce enlargement of the prostate gland and orchitis, so that every man must be in this matter his own doctor. But one will not find logic in this book. In view of what precedes one wonders where the authoress got her degree of M. D., and who is responsible for her education. We must, however, once more commend the spirit of the book, and hope that she will be instrumental in teaching some men and women ordinary temperance. But it must be borne in mind that medical writers chiefly deal with pathological conditions, and that the persons she writes about are mostly abnormal through excess or deficiency.

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General Notes.

MINERALOGY.[1]

Contact Goniometer with two Graduated Circles.—In pursuance of the idea already applied to the reflection goniometer (ref. in this journal, 1895, p. 266) Goldschmidt[2] has designed a contact goniometer with two graduated circles. The horizontal circle carries the support for the crystal, which can thus be rotated about a vertical axis. The vertical circle is a metallic band carrying a moveable block. Through the block a small metal rod passes radially toward the center, and on the inner end of the rod a small plate is fixed. By movement of the crystal about its vertical axis and of the block on its arc, the plate may be brought to parallelism with any face on the upper side of the crystal, Actual contact of the plate with the crystal face is effected by sliding the rod through its block. Readings on the two circles give data for computing the position of a plane, exactly as in the case of the reflection goniometer to which reference was above made.

Crystallographic Properties of the Sulphonic Acid Derivatives of Camphor.—About 17 of these compounds are mentioned by Kipping and Pope[3] with much detailed information concerning the crystallograpy of several of them. As might be expected from the fact that the solutions of many of these substances exhibit the phenomenon of circular polarization, the crystals furnish examples of a number of the less common low symmetry grades. Among these are hemimorphism in the monoclinic system (sphenoidal class of Groth), sphenoidal hemihedrism in the orthorhombic system (bisphenoidal class), and probably hemihedrism in the triclinic system (pedial class). Such crystallographic studies must be of great value to stereo-chemistry.

Optical Properties of Lithiophilite and Triphilite.—On these two minerals Penfield and Pratt[4] have based an interesting investigation of the change of optical properties due to the mutual replacement of manganese and iron in isomorphous mixture. It is found

[1] Edited by A. C. Gill, Cornell University, Ithaca, N. Y.
[2] Zeitschr. f. Kryst., XXV, p. 321, 1895.
[3] Zeitschr. f. Kryst., XXV, pp. 225–256, 1895.
[4] Am. Jour. Sci., L, pp. 387–390, Nov., 1895.

that with increasing percentage of iron the index of refraction increases, while the plane of the optical axes is changed from the base (001) to the macropinacoid (100). A specimen containing 26.58% FeO shows an optical angle of 21° 53′ in the basal plane for thallium light, is *uniaxial* for sodium light, and has an angle of 15° 3′ in the macropinacoid for lithium—a remarkably good example of orthorhombic dispersion. With 35.05% FeO the crystals are found to be negative, whereas those with less iron are optically positive. It is suggested that in the pure manganese molecule, the change may be found so great that the brachypinacoid is the plane of the optical axes.

Native Sulphur in Michigan.—Scherzer[5] reports an occurrence of sulphur a mile west of Scofield, Monroe Co., Michigan. It is found in a stratum of impure cavernous limestone about one to three feet in thickness. The pockets, varying from a fraction of an inch up to three feet in diameter, are often lined with calcite and celestite crystals with bright lustrous masses of sulphur toward the center. The removal of about an acre of this bed has yielded 100 barrels of pure sulphur. The sulphur seems to have originated from hydrogen sulphide which is abundant in the waters of the neighborhood. The hydrogen sulphide, in turn, may be a product of decomposing organic matter.

Leadhillite Pseudomorphs at Granby, Mo.—The occurrence of leadhillite at Granby in the form of pseudomorphs after calcite and galena is made the subject of a note by Foote.[6] Scalenohedrons in a chert calamine rock are composed usually of pure cerussite; more rarely the substance is found to be leadhillite. Galena cubes replaced by leadhillite were also observed. In these cases the secondary mineral is usually mixed with remnants of the original galena, producing a "gray amorphous mass." In a few specimens the leadhillite is pure.

Celestite from Giershagen.—According to Arzruni and Thaddéef[7] the axial ratio of "normal" celestite is $a:b:c = .78093:1:1.28324$. The mineral from Giershagen, which appears to be chemically pure $Sr\,SO_4$, has the ratio $a:b:c = .77962:1:1.28533$. The mean of four determinations places the specific gravity at 3.9665. The optical angle of "normal" celestite is given as $2\,V_{a\,Na} = 50°\,34'$. This investigation adds another to the list of chemically pure compounds whose

[5] Am. Jour. Sci., L, pp. 246–248, Sept., 1895.
[6] Am. Jour. Sci., L, p. 99, August, 1895.
[7] Zeitschr. f. Kryst., XXV, pp. 38–72, 1895.

molecular volume may be considered as accurately known, and allows of comparison between the various physical constants of this and isomorphous substances.

Minerals from the Galena Limestone.—Hobbs[8] gives a detailed description, with many drawings, of the crystallized minerals from the galena limestone of southern Wisconsin and northern Illinois. The habitus of the various crystals is made prominent in the discussion of them. New forms are reported on calcite $(24.0.\bar{24}.1)$, on cerussite (0.25.4), and on azurite (307), (203), $(\bar{2}05)$ and (9.12.8).

Miscellaneous Notes.—Becke[9] shows that the center of symmetry may be used as a fundamental conception in developing the 32 classes of crystal symmetry, notwithstanding the fact of its abandonment by Groth and Fedorow.—Sylvite from Stassfurt, investigated by Schimpff[10] with special reference to the impurities of the same, gave K Cl 99.239, Na Cl .242, $Mg\,Cl_2$ .089, $Ca\,SO_4$ .073, H_2S .0023, residue .108, loss on melting .2847. The foreign substances seem to occur chiefly as inclusions with the mother liquor. These figures doubtless give a very good idea of the amount of impurity present, but the extreme right hand digits must be looked upon as mathematics rather than chemistry.—Igelström[11] finds molybdenum, probably present as Mo_2O_3, in the hematite from the "Sjögrube," Gouv. Örebro, Sweden. One specimen of the same material showed spectroscopically the presence of thallium.—Niven[12] notes the discovery on New York Island of numerous interesting specimens of the rare earth minerals xenotine and monazite. Titanite, epidote, beryl and menaccanite are also mentioned.—The mineral named schneebergite by Brezina[13] on the basis of an apparently faulty qualitative investigation is shown by Eakle and Muthmann[14] to be in reality a very pure lime-iron garnet, or topazolite, instead of a calcium antimonite. The specific gravity is 3.838, and the chemical composition:

[8] Zeitschr. f. Kryst., XXV, pp. 257-275, 1895.

[9] Zeitschr. f. Kryst., XXV, pp. 73-78, 1895.

[10] Zeitschr. f. Kryst., XXV, p. 92, 1895.

[11] Zeitschr. f. Kryst., XXV, p. 94, 1895.

[12] Am. Jour. Sci., L, p. 75, July, 1895.

[13] Vehr. d. k. k. geol. Reichsanstalt, 1880, p. 313.

[14] Zeitschr. f. Kryst., XXV, pp. 244-246, 1895.

	found		calculated for $Ca_3\,Fe_2\,Si_3O_{12}$
SiO_2		35.45	35.43
Fe_2O_3	32.33	32.11	31.50
CaO	32.58		33.07

—Foote[15] gives some details concerning a new mineral which he proposes to name Northupite. It was found by Mr. Northup in the "tailings" from a boring made at Borax Lake, Cal. The crystals are regular octahedrons reaching rarely 1 cm. in diameter. The substance seems to be a double chloride and carbonate of sodium and magnesium. Cleavage imperfect, H = 3.5 to 4.

PETROGRAPHY.[1]

Volcanic Rocks and Tuffs in Prussia.—In the hills east of Ebsdorf, near Marburg, Prussia, are large areas covered by basalt flows, flows of dolerite, and others of rocks intermediate in character between these two, both of which are pre-Tertiary in age, or at any rate are older than the Tertiary beds with which they are associated. The volcanic rocks are cut by dykes of very basic rock resembling limburgite. The little hill west of Wittelsberg, near the northern edge of the basalt area, and the flank of the hill near Kehrenberg, are composed largely of basalt tuff.

The basalt consists of phenocrysts of augite and olivine in a dense felt of augite microlites, biotite and magnetite, in the spaces between which is a colorless glass containing xenomorphic feldspar, leucite and nepheline. Inclusions in the basalt are very common. They comprise besides fragments of foreign rocks, concretions of olivine and of augite. The olivine concretions always contain more or less bronzite, and usually they are surrounded by a violet-brown rim similar to the rims found surrounding the augite phenocrysts in the basalt. Even those concretions that are composed almost exclusively of bronzite are surrounded by rims of this character. The principal component of this rim is a monoclinic augite, so that it appears here that the bronzite, which must have been one of the earliest separations from the magma, was, after its crystallization, changed into augite. Other concretions show the

[15] Am. Jour. Sci., L, pp. 480–488, Dec., 1895.

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

alteration of the bronzite into olivine. By complete fusion one concretion, which is thought by the author to have been a bronzite-augite aggregate, has been changed to a mass of rounded augite and olivine grains imbedded in a glass which locally is replaced by nepheline. The alteration of the bronzite, as indicated by the study of a number of sections, is into olivine, augite, magnetite and glass. Among the rare constituents of the olivine concretions are chrome diopside and picotite. The augite concretions or inclusions, consist almost exclusively of a monoclinic augite with which is usually associated a little olivine. In the interiors of the concretions the augite contains fluid enclosures, but toward their peripheries the enclosures are all of glass. Often between the augite grains are little nests of calcite. One of the inclusions observed by the author is abnormal in that it is composed of a small nucleus of augite surrounded by a zone of brown biotite.

Of the foreign inclusions, the author describes two kinds—the calcareous and the granitic. The basalt in the neighborhood of limestone inclusions loses its biotite and magnetite. Nearer the inclusions the augite microlites become light colored and magnetite grains are again developed. At the boundary of the limestone fragment is a rim of large augites, whose ends are directed toward the center of the inclusion. This latter itself is composed of the remnants of calcite grains imbedded in a brown glass, in which are also well formed crystals of a scapolite. The sandstone inclusions have been changed to a mass of quartz grains lying in a brown glass, the whole being surrounded by the usual zone of augite microlites. The granite inclusions first lose their mica. The old feldspar has given rise to newly developed feldspar.

The dolerite seem to occur as a number of small flows that have run together. It presents no special peculiarities. The dyke basalt cutting the tuffs and dolerites sometimes contains well defined crystals of olivine, which occasionally occur as interpenetration twins.

Igneous Rocks of British Columbia.—The petrographical characters of the principal rocks occurring within the area of the Kamloops Map-sheet of British Columbia are described by Ferrier.[2] These rocks embrace feldspathic actinolite schists, diabase porphyrites, harzburgite, amphibolites, diabase tuffs, cherts, gabbros, orthophyres, augite-porphyrites, porphyrites, basalts, pecrite-porphyrites, andesites, trachytes, dacites, diorites, granites, syenites, quartz-porphyries, alnoite and a series of much altered rocks. The descriptions are all brief.

[2] Annual Rep. Geol. Surv. of Canada, Vol. VII, Pt. B., p. 349,

Chalcedony Concretions in Obsidians from Colorado.—Patton[3] describes the occurrence of large opal and chalcedony concretions or geode-like bodies in beds of a decomposed obsidian on Ute Creek in Hinsdale Co., Colorado. The concretions are most common in the upper scoriaceous portions of the flows. Similar concretions were also found in a rhyolite at Specimen Mountain. The concretions are composed of radial fibres of chalcedony. The flowage lines that are common to the rock pass uninterruptedly through them, and in them are trichites exactly like those in the body of the rock. The concretions are regarded as secondary in origin—and as due to the percolation of silica-bearing waters through the rock. The same author publishes some photographs of erosion forms produced by the weathering of the volcanic conglomerates in the San Juan Mountains.

Basic Dykes near Lake Memphremagog.—According to Marsters[4] the Chazy limestones of Lake Memphremagog are cut by granite, olivine, diabase and lamprophyre dykes. The latter comprise dark rocks containing phenocrysts of augite, hornblende or olivine. The olivine, when it occurs, is always situated in the central portions of the dykes. Sometimes its crystals are one and half inches in diameter. Petrographically these rocks are augite camptonites, fourchites and monchiquites. The augite camptonite contains both augite and hornblende in two generations and in varying quantities. Only two fourchite dykes were observed. Their material presents no unusual features. The paper is interesting as bringing to our knowledge another area in which these peculiar and interesting dyke rocks occur.

The Origin of the Maryland Granites.—The last article written by the late Dr. Williams[5] is an introduction to Keyes article on Maryland granites. In this paper the author explains the criteria by which ancient plutonic rocks may be recognized in highly metamorphosed terranes, and applies the principles thus established to prove the eruptive nature of many of the Maryland granites. The pegmatites of the Piedmont plateau were tested by the same criteria, with the result that these too are pronounced to be eruptive. Many handsome plates embellish this portion of the paper. In the main portion of the article Keyes describes the petrographical features of the different types of granite, giving special attention to the original allanite and epidote found in them. There is little that is new in the paper, most of its

[3] Proc. Colo. Scient. Soc , Nov. 4, 1895.
[4] Amer. Geol., July, 1895, p. 25.
[5] 15th Ann. Rep. U. S. G. S., 1895, p. 653.

essential points having already been discussed by Hobbs, Grimsley and others.

Petrographical Notes.—The rocks of the Laurentian area to the north and west of St. Jerome, Quebec, are briefly referred to by Adams[6] as gneisses, anorthosites, amphibolites, limestones, quartzites, etc. Some of the gneisses are eruptive and others are probably sedimentary.

Miller and Brock[7] have found in Frontenac, Leeds and Lanark Counties, Ontario, granites, gabbros, scapolite and pyroxene rocks of Laurentian age cut by dykes of quartz gabbro containing phenocrysts of pyroxene and plagioclase.

Keyes[8] declares that the granites and porphyries occuring in the eastern portion of the Ozarks, in Missouri, "are very closely related genetically, and are to be regarded as facies of the same magma," the porphyry being the upper and surface facies of the granite.

GEOLOGY AND PALEONTOLOGY.

Canadian Paleontology.—In addition to the vertebrates (reptilia and batrachia) and land snails discovered by Sir Wm. Dawson in the interior of erect trees in the coal formations of Nova Scotia, and described by him in various scientific publications, fragments of arthropods have been found in the material collected. These were submitted for examination to Mr. Samuel Scudder who published a preliminary report in 1882, and now, after completing his study, gives these additional facts. A few species of Myriapods show traces of the bases of spines; the ventral plates in Archiulus are very broad; two new species of this genus are recognized; two species of Mazonia are indicated, one of which (*M. acadica*) confirms the separation of this genus from Eoscorpius; a facetted eye taken from a reptilian coprolite shows the presence of a true insect, probably a cockroach.

A report upon the Cenozoic Hemiptera of British Columbia, by the same author, comprises descriptions of nineteen species. Mr. Scudder calls attention to the great variety among these insects. Among the Homoptera, every specimen must be referred to a distinct species, and

[6] Ann. Rep. Geol. Surv. of Can., Vol. VII, J., p. 93.
[7] Can. Record of Science, Oct., 1895.
[8] Bull. Geol. Soc. Amer., Vol. 7, p. 363.

in only one case can two species be referred to one genus. In the Fulgoridae each of the three species belongs to a different subfamily. Another striking feature of the fauna is the size of the individuals which compose it. The majority of them represent the most bulky species of their respective families. The average length of these Cenozoic species of Fulgoridae and Cercopidae is not less than two centimeters, and there are some that are double that length.

The author states that this insect fauna indicates that the deposits in which they occur are at least as old as Oligocene, but no definite statement as to the age of the beds can be made.

A third interesting paper in this series on Canadian fossil insects sums up the present knowledge of the Coleopterous remains of Canada. These have been found in seven distinct localities in that country, and at three very different horizons. The greatest interest attaches to the collection made at an interglacial locality near Scarboro' Ont., which yielded twenty-nine species, and is the largest assemblage of insects ever found in such a deposit anywhere. Forty-five species from the various localities are described by Mr. Scudder. They are referred to 27 genera, 2 of which are new. (Contrib. Canadian Paleontol., Vol. II, Pt. I.)

Jackson on the Development of Oligoporus.—The following is an abstract of the results of the recent studies of the Palæoechinoidea. In Oligoporus the interambulacra terminate ventrally in two plates, which present on their oral faces a reëntrant angle for the reception of a single initial plate of the area. Proceeding dorsally, new plates and new columns of plates are added, accenting by their appearance stages in growth, as he had previously shown in Melonites, until the full compliment of the species is attained. The single initial interambulacral plate of Oligoporus was compared with a similar plate in Melonites, Lepidechinus, young modern Cidaris, etc. At the ventral or younger portion of the corona of Oligoporus there are only two columns of ambulacral plates. The four columns characteristic of the adult are derived from these two by a drawing-out process. The four columns of ambulacral plates of adult Oligoporus are the equivalent of the two outer and two median columns of Melonites. These four columns in both genera are the morphological equivalent of the two columns seen in the ambulacra of Bothriocidaris, Cidaris, etc.

Oligoporus, as shown by the development of both ambulacral and interambulacral areas, is a genus intermediate between Palæechinus and Melonites. During the development of Oligoporus it passes

through a Rhoëchinus stage, and later a Palæechinus stage. Melonites in its development passes through an Oligoporus stage.

An early stage in developing Echinoderms was named the "protechinus" stage. At this stage are first acquired those features which characterize the developing animal as a member of the Echinoidea. The protechinus stage in Echinoderms is directly comparable to the protoconch of Cephalous Mollusca, the protegulum of Brachiopods, the protaspis of Trilobites, etc. The Echinoderm at this period in its growth has a single interambulacral plate (representing a single column of such plates), and two columns of ambulacral plates in each of the five areas. This stage is seen in Oligoporus, Lepidechinus, Goniocidaris and other genera; it finds its representative in an adult ancestral form, in the primitive, oldest known genus of the class Bothriocidar is of the Lower Silurian, which has but one column of interambulacral and two columns of ambulacral plates in each area.

Species of Oligoporus and Melonites with few interambulacral columns are considered the more primitive types, as they are represented by stages in the development of those species which acquire a higher number of columns in the adult.

The structure of the ventral border of the corona of Archæocidaris was described. It presents a row of plates partially resorbed by the encroachment of the peristome, as in modern Cidaris, etc. Ambulacral and interambulacral plates on the peristome were described in Archæocidaris, also teeth and secondary spines on the interambulacral plates of the corona.

This paper contains a classification of Palæozoic Echini based on the structure and development of the ambulacral and interambulacral areas and the peristome. It will be published in the Bulletin of the Geological Society of America.—Science, Nov. 22, 1895.

American Fossil Cockroaches.[1]—This memoir, published as Bulletin 124 of the U. S. Geological Survey, is a revision of the known species of American fossil cockroaches to date. The descriptions of new forms are interpolated in a systematic list of all the species yet recovered from the rocks, and such tables have been added as may enable the student to readily determine any new material. With the publication of this essay all species hitherto described will have been figured.

[1] Bulletin of the United States Geological Survey, No. 124. Revision of the American Fossil Cockroaches, with Descriptions of New Forms. By Samuel H. Scudder, Washingtou, 1895.

The new forms are Paleozoic, and are mostly from two new localities—Richmond, Ohio, and Cassville, West Virginia. There are, however, a number of new species from old horizons.

Tables of the geographical and also of the geological distribution of both American and European genera are given in the introduction, followed by a statement of the characteristics of the Mylacridae and a discussion of some of the anatomical features of paleozoic cockroaches. In this connection the author calls attention to possible mimicry among these old forms of insect life, and figures side by side a cockroach wing and a fern frond found associated in the same beds, to show how close is the resemblance between them in the general distribution of nervures and in outline.

The illustrations comprise twelve page plates and three figures in the text.

The Comanche Cretaceous.—Prof. R. T. Hill has found some outlying areas of the Comanche series in Barber and Comanche Counties, Kansas, and in G County, Oklahoma, and in the Tucumcari region of New Mexico. These strata are identified from paleontological evidence.

The importance of a correct determination of these beds is evident from the following concluding remarks of the author.

"The geology of the outlying areas of the Cretaceous preserved in the scarps of the Plains adds greatly to our knowledge of the distribution, variation, paleontology and history of the beds of the Comanche series, and of the progressive oscillatory conquest of the Great Plains region by the sea in Cretaceous time. The Belvidere (Kansas) beds have revealed the following additions to our knowledge of Cretaceous paleontology: First, a lower stratigraphic occurrence of the dicotyledonous Dakota flora than known, whereby we may now say that dicotyledons make their first appearance before the beginning of the Washita subepoch, instead of in the Dakota as hitherto believed. Second, a similar downward range in the geologic scale of the ichthyic vertebrates of hitherto supposed Upper Cretaceous range. Third, intermingling of these plants and fishes with molluscan species and other vertebrates of the Washita division such as has not hitherto been found in the Comanche series." (Amer. Journ. Sci., Lol. L, 1895).

Kolguev Island, which lies 130 miles southeast of Novaya Zemlya, differs, according to Col. Feilden, in geological structure, both from mountainous islands of its neighbor and from Russian Lapland. The entire elevated region of the island is composed of beds of sand contain-

ing erratic boulders. to a depth of not less than 80 feet, and these sandy beds rest on the Kolguev clays. These in turn are 50 miles long by 40 wide, with a thickness of not less than 250 feet, probably more. This great mass is evidently a glacio-marine deposit. A few molluscan remains were found in it, all well known boreal forms existing at the present time, but no vertebrates nor drift-wood. A collection of erratics made by the author are identified by Prof. Bonney as rocks of Mesozoic age, either Jurassic or Wealden. (Quart. Journ. Geol. Soc., 1896.)

Palæontologia Argentina.—Vols. I (1891), II (1893), and III (1894).—The Museo de la Plata of Argentina has progressed thus far with the publication of monographs illustrative of its magnificent collection of fossil vertebrata of that country. The style of the publication is worthy of the subject; the size selected being folio, and the plates phototype reproductions of the originals, often of the natural size. The whole is issued under the supervision of the director of the Museum Dr. Francisco P. Moreno, who contributes some of the articles in connection with M. Mercerat; while Dr. Lydekker, of London, furnishes the greater number.

The first volume, on the extinct birds of Argentina, consists solely of plates, with pages of names referring to the figures. These plates depict objects of great interest, many of the bones belonging to the extraordinary family of the Phororhacidæ of Ameghino, which seem to be nearly allied to the existing Cariamidæ of South America. Most of these birds are of gigantic size, and their powerful legs and hooked beaks indicate that they were quite competent to maintain their place in the fauna of which they form a part. We have waited for some years before noticing this valuable publication, in hopes that the text would appear. It seems, however, that there is no intention of publishing a descriptive part. Under the circumstances we must regret that names were attached to the figures, for, although figures may give currency to specific names, they cannot do so for names of any higher grade, and a considerable amount of synonymy has been thus created. Dr. Ameghino has also subsequently shown, that in this atlas a good many duplicate names have been given to the same species.

In the second part are published three memoirs by Dr. Lydekker. These include figures and descriptions of Dinosauria and Cetacea from Patagonia, and mammalia Ungulata from the same region. The magnificent plates are accompanied by descriptions, and this volume is therefore more valuable than its predecessor. Unfortunately the de-

scriptions are quite inadequate, and the specimens will have to be more fully described before their characters can be sufficiently known.

The third volume is chiefly occupied with the Edentata, and this memoir is admirably illustrated. The descriptions (by Dr. Lydekker) are rather more full than those of Vol. II, but not full enough. They are marred by frequent supercilious references to Dr. Florentino Ameghino, who is the most competent paleontologist of the vertebrata in South America, and whose descriptions compare very favorably with those of other paleontologists in all respects. His figures are not so good as those of the work now under review, for here we have a case in which the most skilful hand has not had the financial advantages it ought to have had. From our past experience we should say that when Dr. Lydekker states that organic forms are distinct species he is apt to be correct; but when he identifies forms alleged to be distinct, further examination is in order.—C.

BOTANY.[1]

Tilden's American Algæ.—The first century of this distribution by Josephine Tilden, of Minneapolis, was sent out about a year ago, but has not hitherto been noticed in these pages. The specimens are very neatly prepared, and are attached to cards or mica slips. In most cases they contain an abundance of material, but, in a few instances, we might wish for more generous specimens. The species represent the following genera:

Oedogonium (4), *Sphaeroplea* (1), *Hormiscia* (2), *Chaetophora* (4), *Draparnaudia* (3), *Stigeoclonium* (6), *Conferva* (1), *Microspora* (1), *Urospora* (1), *Cladophora* (15), *Pithophora* (1), *Vaucheria* (5), *Botrydium* (1), *Hydrodictyon* (1), *Tetraspora* (2), *Palmella* (1), *Protococcus* (3), *Euglena* (1), *Spirogyra* (10), *Cosmarium* (1), *Porphyrosiphon* (1), *Symploca* (2), *Lyngbya* (2), *Phormidium* (1), *Oscillatoria* (8), *Spirulina* (1), *Gloeotrichia* (2), *Tolypothrix* (1), *Nostoc* (3), *Anabaena* (2), *Merismopedia* (1), *Navicula* (1), *Pleurosigma* (1), *Gomphonema* (2), *Cocconeis* (1), *Nitzschia* (1), *Odontidium* (1), *Synedra* (2), *Fragilaria* (1), *Cystopleura* (1), *Lysigonium* (1).

The introduction of *Euglena* among plants is, in our opinion, a mistake, although one which will probably do no harm, since it will be difficult if not impossible to recognize them from dried specimens.

[1] Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska.

Century II is announced to appear soon. We bespeak for it a liberal patronage.—CHARLES E. BESSEY.

The Columbines of North America.—Thirteen species of *Aquilegia* are described as occurring in North America in Robinson's edition of Gray's Synoptical Flora (1895).

These fall into two types, as follows:

A. Old World type, with hooked or curved spurs:

A. brevistyla, Rocky Mountains of British America, and the Black Hills of South Dakota.

A. saximontana, Rocky Mountains of Colorado.

A. flavescens, Pembina and British Columbia to Oregon and Utah.

A. micrantha, southeast Utah.

A. ecalcatata, southwest Colorado.

A. jonesii, northwest Wyoming and Montana.

B. American type, with straight spurs:

A. canadensis, common east of the Rocky Mountains.

A. formosa, Alaska to northern California, Idaho and Utah.

A. truncata, California.

A. caerulea, Rocky Mountains from Montana to New Mexico.

A. chrysantha, southern Colorado to New Mexico and Arizona.

A. pubescens, California.

A. longissima southwest Texas.

It is interesting to note that in Torrey and Gray's Flora of North America (1840) there were but four species described, viz.: *A. canadensis*, *A. formosa*, *A. caerulea* and *A. brevistyla*. It is possible that some of these species may be reduced to varieties upon a more critical study of the genus, but even with the most rigid reduction we should still be left with a large representation of these interesting plants. Their curious beauty and comeliness, with their general distribution, may well warrant the suggestion which has been made to make the Columbine our national flower.—CHARLES E. BESSEY.

Sets of North American Plants.—Two sets of peculiarly interesting North American flowering plants attract the attention of herbarium curators at this time. They consist very largely of species from Florida, that wonderfully rich semi-tropical region whose botanical treasures we are just learning to appreciate. The first is a set of 400 specimens by the veteran collector A. H. Curtiss, of Jacksonville, Florida. A personal examination of the specimens warrants the same high commendation which all of Mr. Curtiss's work has hitherto received.

The second set is published by G. V. Nash, of Washington, D. C., and includes the same number of specimens. A glance at the list shows it to include many rare and a considerable number of new species. Either set would be a valuable acquisition to any college herbarium.—Charles E. Bessey.

Botany in Buffalo.—The Secretary of the Section of Botany (G) of the American Association for the Advancement of Science, Professor George F. Atkinson, of Ithaca, N. Y., is making an effort to provide a good programme for the meeting in August (24 to 28). Titles and abstracts of papers are to be sent to the Secretary not later than July 1, in order that they may be arranged and forwarded to the Permanent Secretary of the Association for printing and distribution. It is the purpose of the Association to issue such a list of Section programmes not less than a month preceding the meeting. Let every botanist who has something of importance send in his title *and abstract* on or before the first day of July.

The second annual meeting of the Botanical Society of America which will be held on August 21 and 22, in connection with the Association, should attract a good number of the more advanced men in the science. Dr. Trelease, the retiring president, will deliver his address on "Botanical Opportunity" at 8 P. M. of the 21st. On the 22d there will be forenoon and afternoon sessions for the reading of papers and discussions.—Charles E. Bessey.

Blanks for "Plant Analysis."—For some time there has been an encouraging decrease in the annual crop of blanks for "plant analysis," and we hoped to be able soon to announce the complete extinction of the species. It appears, however, that there are certain intellectual soils in which they still thrive, in spite of the fact that, like the Russian Thistle, they are outlawed in most communities. We have before us two which bear the date 1896, one from U. O. Cox, of Mankato, Minnesota, and the other from H. J. Harnly, of McPherson, Kansas. If one may distinguish between things which are necessarily bad, it may be said that the first is the better of the two. Its fault (which is fatal) is that it enables the pupil to "analyze" a plant with the least possible thinking: he does not have to remember anything; he merely reads the question, looks at his plant, and makes his entry on the proper line. The second blank (which is "copyrighted") adds to the foregoing much which is confusing and scientifically vicious. Thus the pupil finds the questions "Flowers, Regular or Irregular? Why?" which he is expected to answer in a line just *two and a half inches long!*

Again he is asked, "Flowers, Complete or Incomplete? Why?" and is allowed a line exactly two inches long in which to give an answer to a question before which the wisest botanist may well quail. When will teachers realize that botanists are not made by the use of such "helps" any more than Latin scholars are made by the use of "ponies"?

—CHARLES E. BESSEY.

Botanical News.—The Director of the Missouri Botanical Garden at St. Louis calls attention in a printed circular to the advantages for study afforded by this important institution. Its herbarium includes nearly 250,000 specimens, and its library about 10,000 volumes and 11,000 pamphlets.

A. H. Curtiss, of Jacksonville, Florida, is distributing fine sets of the Marine Algæ of Florida. Each set contains fifty species and is sold for five dollars.

Professor Bruce Fink, of Fayette, Iowa, offers sets of Iowa Lichens, including about 200 species which he sells at the low price of six cents each.

We are glad to see another number of *Pittonia*, the very useful periodical which Professor E. L. Greene issues from time to time. The new part (13) contains papers on the Nomenclature of the Fuller's Teasel, a Proposed New Genus of Cruciferae; New or Noteworthy Species; New Genus of Polemonianae, and New Mexican Eupatoriaceæ—CHARLES E. BESSEY.

ZOOLOGY.

Japanese Leeches.—The discovery of three new land leeches in Japan is of interest to geologists since but one species, *Haemadipsa japonica* Whitman, is all that has been known to occur in that country. The three new species are members of a genus separated from all the genera of land leeches hitherto defined. An account of their external characters and a general outline of their internal organization are presented by Dr. Asajiro Oka in a recent number of the journal published by the Imperial University of Japan. For the new genus the author proposes the name Orobdella. The species of this genus are found in various mountainous parts of Japan, crawling under moss and fallen leaves, or in moist earth, in the same manner as earthworms, which con-

stitute the chief source of their nourishment. Having no jaws, these leeches can neither bite nor suck blood, but swallow the worms entire. *O. octonaria* is one of the largest leeches known. The dimensions of one specimen found by the author is given, length 270 mm., width 14 mm., depth 10 mm.

Dr. Oka adopts the classification of R. Blanchard (1894), and shows the systematic position of Orobdella in the following synoptical table:

Ordo Hirudinea.
- a. Subordo. Rhyncobdellae.
- b. Subordo. Arhyncobdellae.
  1. Fam. Gnathobdellidae.
     Aquatic: gen. Hirudo, Haemopis, etc.
     Terrestr. gen. Haemadipsa, Xerobdella, Mesobdella.
  2. Fam. Herpobdellidae.
     Aquatic: gen. Herpobdella, Dina, Trocheta.
     Terrestr: gen. Cylicobdella, Lumbricobdella, Orobdella.

(Journ. Coll. Sci. Imp. Univ. Japan., Vol. VIII, Pt. 2, 1895.).

The Origin of Tail-forms.—The use and meaning of the asymmetrical types of tail-fin which are so commonly met with among fishes—e. g., the upturned tail of the shark and sturgeon, and the downwardly extended fin of the flying-fish, are explained by Dr. F. Ahlborn by comparisons founded on experience in rowing. Every tyro knows the consequences which ensue if he holds his blade too obliquely in the water. If the upper edge is inclined too much towards the stern of the boat a brisk pull upon the handle results in the blade jumping out of the water; if, on the other hand, the blade is inclined too much in the opposite direction, it digs into the water and the oarsman "catches a crab." The relevance of these illustrations is found in the fact that the skeletal support of the asymmetrical tails of fishes is generally such that either the upper or lower border of the fin is more resistant to the pressure of the water than the opposite border, a fact which causes the fin in action to assume an oblique instead of a vertical position. The result of such a disposition is that in those cases where the upper part of the tail is stiffer than the lower, the tail in locomotion is driven upwards, as the oar is driven out of the water (heterocercal tail of shark and sturgeon); while in cases where the lower part of the tail is firmer than the upper, the tail tends, in action, to assume a lower position than the rest of the body (flying-fish). The body of the animal, in fact, is made to swing vertically about a horizontal axis running through the center of gravity: in the first group

the tail becomes elevated above the head, in the second group the head becomes raised above the tail. The utility of these types of organization becomes obvious when the habits of the creatures which exhibit them are considered. The first group consists of bottom-haunting fish, which are thus enabled to give free play to their tails while scouring the sea-bottom in search of food ; the second consists entirely of surface-swimming forms which are enabled, by this beautiful adaptation of structure, to swim swiftly beneath the surface of the water without the risk of their tails emerging, and so cause inconvenience and waste of force. The tails of many air breathing aquatic animals, such as the sea-snake and the extinct Ichthyosaurus are constructed upon this latter principle. (Nature, Feb., 1896.)

The Spermatheca in some American Newts and Salamanders.—The term *receptaculum seminis* has been used to designate certain structures in the cloacal wall of the female *Necturus maculatus*, which serve as reservoirs in which the zoösperms of the male are received. In order to have a better understanding of the function of these structures, Dr. Kingsbury undertook a study of the cloaca in the female of six species of Urodeles (American). The chosen species represent five families, and two orders of Batrachia, and present a good series from a purely aquatic to as purely a terrestrial existence. The general result has been a recognition of these organs in one form or another in all the species under observation, but there is no unity of structure, hence the term *receptalum seminis* is not strictly applicable, and the mononym *spermatheca* is proposed instead. In some forms many spermathecas would be recognized.

In Diemyctylus, Amblystoma and Necturus the spermathecas assume the form of individual tubules. In Amblystoma the tubules are arranged around depressions. In Spelerpes, Plethodon and Desmognathus consists of a tubular depression of the cloaca into the end of which the clustered tubules open.

As to how the spermatozoa find their way into these resting places, the author suggests that while the theory of Pfeffer of "positive chemotaxis" is highly probable, yet it is also possible that the entrance of the zoösperms may be solely due to their own activity assisted by muscular contractions of the cloaca and spermatheca.

The results of Dr. Kingsbury's observations are thus summarized :—

1. In the genera Necturus, Amblystoma, Diemyctylus, Plethodon and Desmognathus, spermathecas are found in the dorsal wall of the

cloaca of the female, containing zoösperms. Internal fertilization is therefore proven for these forms.

A spermatheca occurs in Spelerpes; in the single specimen examined (taken in the fall) no zoösperms were contained.

In Necturus, Diemyctylus and Amblystoma, there are several tubules or spermathecas opening upon the cloacal epithelium, which serve as reservoirs for the semen.

In Desmognathus, Plethodon and Spelerpes, there is a single mesal spermatheca.

The condition in Spelerpes would seem to indicate that the organ in these latter genera equals the group of tubules found in the first genera plus and exaggerated and modified depression of the cloacal epithelium, such as occurs in Amblystoma.

2. No gland-like structures in addition to the spermatheca occur in the female of Plethodon and Desmognathus.

3. In all the remaining genera a ventral cloacal gland is present.

4. In Amblystoma, Spelerpes and Necturus, in addition to the spermatheca tubules, other tubules occur on the dorsal side of the cloaca.

5. The secretion of the cloacal glands is employed at the time of ovulation.

6. The three glands of the male recognized in the Triton, the cloacal, abdominal and pelvic, occur and are well developed in the five genera examined. This suggests that by all of these spermatophores are deposited.

7. A résumé of the literature and foregoing facts points to a uniform mode of mating and fertilization in all urodeles.

8. Dorsal and ventral ciliated tracts occur in the male of all the genera examined. Cilia in the cloaca of the female were detected only in Amblystoma and *Plethodon glutinosus*, where the tract was not as extensive as in the male. (Proceeds. Amer. Microscop. Soc., Vol. XVII, 1895.)

Zoological News.—A second species has been added to the genus Opisthoteuthis founded by Verrill to receive a West Indian species named *O. agassizi*. The new acquisition was obtained by a Misaki fisherman with a hook at a depth of about 25 fathoms in Iagami Bay, Japan. It is described and figured by Dr. Ijima and S. Ikeda under the name *O. depressa*. (Journ. Coll. Sci. Imp. Univ. of Japan, Vol. VIII, Pt. 2, Tokyo, 1895.) This genus is characterized by the fact that the alimentary canal passes directly through the body, instead of

returning to issue near the mouth. Ferrill regards it as the most primitive form of the Cephalopoda.

A new genus of Cottoid fishes from Puget Sound is described by Mr. E. C. Starks. The type species, *Jordania zonope* is in the Museum of the Leland Stanford, Jr., University. (Proceeds. Phila. Acad. Nat. Sci. [1895] 1896).

Mr. J. A. Allen emphasizes the fact that the change of color in the plumage of birds without moulting is due to the gradual wearing off of the light colored edges of the feathers, combined with the more or less blanching of the color of certain parts. Exposure to the elements and friction also produce more or less marked change in color. The author prefaces his remarks with a brief history of origin and persistence of the theory unwarranted by the facts that the feathers of birds change color with the season independent of the process of moulting. (Bull. Amer. Mus. Nat. Hist., Vol. VIII, 1896.)

ENTOMOLOGY.[1]

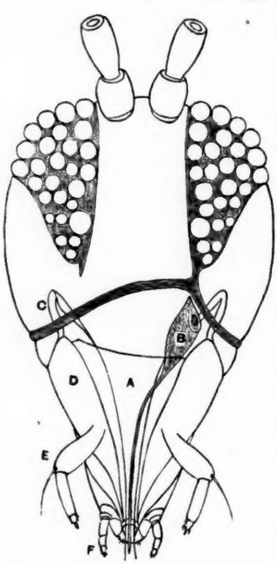
The Asymmetry of the Mouth-parts of Thysanoptera.—In the Bulletin of the Essex Institute, for 1890, Vol. XXII, the writer published a brief account of some peculiarities he had observed in the mouth-parts of members of this order of insects, and ventured in explanation, the hypothesis that in these insects the mandible of the right side of the head is wanting, and that the parts commonly regarded as mandibles are lobes of the maxillæ. Subsequently the writer called this anomalous condition of the mouth-parts to the attention of members of the Entomological Club of the American Association for the Advancement of Science (Indianapolis meeting, August, 1890) and presented slides showing the peculiarities described. (See Canadian Entomologist, 1890, Vol. XXII, p. 215.)

Nothing, so far as I know, has appeared in American literature since that time with reference to the matter, and the old view concerning the structure of the mouth seems to be still current. In Prof. J. H. Comstock's excellent manual, recently issued (1895) the labrum is represented as perfectly symmetrical, the parts considered by him to be mandibles are incompletely represented, and no mention is made of

[1] Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

any unusual feature of the mouth structure. In giving the characters of the order, he says: "The mouth-parts are probably used chiefly for sucking; they are intermediate in form between those of the sucking and those of the biting insects; the mandibles are bristle-like; the maxillæ are triangular, flat, and furnished with palpi; the labial palpi are also present."

I have just examined a copy of Jindrich Uzel's "Monographie rádu Thysanoptera," 1895, perhaps the most extensive work yet published on the Thysanoptera, in which the view of the mouth structure described by me in the Bulletin of the Essex Institute and before the Entomological Club is adopted, though Uzel is disposed to take a different view of the homology of the unpaired mouth-part. His words are (Ibid, p. 25): "In der Höhlung des Mundkegels bewegen sich die Mondibeln in Form zweier Stechborsten und der unpaare Mundstachel (wohl ein umgebildeter epipharynx) welcher linkerseits liegt und den für die Thysanopteren characterischen Unsymmetrischen Bau der Mundwerkzenge bedingt." In order to show more clearly what the unpaired part is like, I have made a drawing from his Figure 161, Tab. IX, which is here reproduced.



Of the interpretation Uzel is disposed to put upon the unpaired part, I have only this to say: It is plainly closely adapted to the left side of the head, and the parts belonging to the region in which it lies are closely adapted to it. It is very evident that it was made to fit in the angle formed by the hard parts of the head on the left side; the labrum is, on this side, shortened and otherwise suited to accommodate it. A reëxamination of my slides shows the adjustment more complete even than represented in Uzel's figure. Coupled with this is a manifest deficiency in the head on the right side at the place where a corresponding structure should be. It is evident that something is lacking on the right side. If the unpaired organ is an epipharynx that has been displaced, why should the cranial structure of the right side be altered?

The further question arises, why should an epipharynx be pushed to one side and completely shaped to the structures there?

I have suggested that the pair of slender parts, called by Uzel and others mandibles, may be lobes of the maxillæ, and urged in explanation that they are attached to parts regarded by everybody as maxillæ, and besides that they are composed of two divisions (Professor Comstock does not represent the basal piece at all and hence the slender distal part appears in his figures as if free from the maxilla). Uzel figures this pair of mouth organs, as I have done, attached to the bases of the palpus-bearing parts, and as composed of a short basal piece and a long slender distal one. He says nothing of their jointed character but represents an articulation in the right one of his figure 161. They appear to me to be two-jointed and with this true, to consider them mandibles is to assume a departure from the one-jointed condition of the mandible prevailing in Hexapoda.

In the proceedings of the Entomological Club of the American Association (Can. Ent., Vol. XXII, p. 216), I am reported as stating that two unmistakable tarsal claws are present in Plæothrips and that the vesicle is probably a modified pulvillus. Prof. Comstock says: "The tarsi are two-jointed, bladder-like at the tip, and without claws." Uzel, on the contrary, states that claws are more or less developed in all Thysanoptera. "Beine Kurz; der eine-bis zweigliedrige Tarsus am Ende mit zwei mehr oder wenlger deutlichen Klanen, welche an Blase anwachsen."

Prof. Comstock's work has been quoted simply because it represents the established American view of the structure of Thysanoptera, a view which must certainly be changed in some particulars. To what extent the asymmetry referred to has been studied by foreign entomologists I am unable to say, since I have not been so situated as to be able to keep close track of the foreign literature. Thus far I have seen no reference to it except that in Uzel's work.

Explanation of the Figure.

Front view of head of *Aeolothrips fasciata*. A, the unsymmetrical labrum; B, the unpaired mouth-part (mandible, according to my interpretion, epipharynx according to Uzel); C, lobe of maxilla (mandible of Uzel and other authors); D, the maxilla; E, the maxillary palpus; F, the labial palpus.—H. Garman.

A New African Diplopod Related to Polyxenus.—While collecting insects in the darker parts of the Liberian forests, I have on

a few occasions noticed what appeared to be large individuals of Polyxenus of a dark brownish color, running about on the smooth leaves of the shrubby undergrowth, several feet from the ground. To preserve and carry to America specimens in satisfactory condition is not easy, and hence the present purpose of describing the external features of one found yesterday and having nearly all the bristles still in place.

SAROXENUS g. n.

Body minute, tapering caudad.

Head rounded, not as broad as the first segment; between the eyes with an anterior crescentic tiara of long upright serrate bristles: on each side between and above the eyes a short curved line of similar hairs elsewhere the head is smooth.

Eyes of a few (six ?) small ocelli clustered on lateral prominences of the head.

Antennæ long and slender, distinctly clavate; sixth joint longest and much the thickest; seventh slightly longer than any of the proximal; eighth joint distinct, minute, several times smaller than the seventh.

First segment with six tufts of bristles, two in front, two behind and one on each side; the dorsal tufts are broader transversely; the lateral are raised on large projections, as in Polyxenus, and include more numerous and longer bristles.

The following six segments have each four tufts of similar bristles, two lateral and two posterior, the latter broad, as on the first segment; the bristles are longer and the tufts larger on posterior segments.

Last segment with a nearly complete transverse row of divergent bristles just in front of the dense brush of much finer, closely compacted bristles which compose the terminal fascicle.

Saroxenus scandens sp. n.

General color dark grayish brown, the terminal fascicle nearly white; in alcohol and under the microscope, the bristles of the head and segments are seen to be dark brown; the distal joints of the antennæ and legs are pinkish brown, and the exposed portions of the integument have a tinge of the same color; integument generally waxy or dirty white, and transparent so that the contents of the alimentary canal are visible as a dark line; eye spots dark brown.

Segments 8, though the specimen may not be mature; ten pairs of legs.

Length 3.5 mm., or with the terminal fascicle 4 mm.; width 1.2 mm., including the bristles.

Locality, Running about on the leaves of undergrowth, in the forest on Cape Mesurado, Liberia.

Under sufficient magnification the bristles of the head and segments appear as round hollow structures with about four longitudinal rows of very fine appressed teeth directed distad. The bristles of the terminal fascicle are more slender and have for a part of their length large appressed spines in opposite pairs something as shown by Latzel for *Polyxenus lagurus*. Nothing was seen similar to the apices of the hairs as figured by the same author.

This new genus is to be distinguished from Polyxenus and Lophoproctus[2] by the form of the antennæ and the distribution of the dorsal setæ. In Polyxenus the antennæ are short; in Lophoproctus they are long, but the apical joint is subequal to the penultimate.

Polyxenus has two transverse dorsal rows of rather remote short clavate and strongly serrate setæ, while Lophoproctus has a single row. The type of the latter genus is eyeless, although Mr. Pocock proposes to inclnde a species with eyes, *Polyxenus lucidus* Chalande.

From the West Indes Mr. Pocock has described another Polyxenus[3] which, to judge from the drawing, has four tufts of setæ on each segment, and also a scattering row along the posterior margin. The antennæ are said to be very long, but appear not to be clavate, and the relative proportions of the joints are not stated. It is probably the type of a new genus having affinities with the African rather than with the European forms.

By the discovery of Saroxenus the distribution of the Pselaphognatha is considerably extended. Should members of the group be found in other tropical regions there will be added assurance of the antiquity of the subclass, and of the probability of relationship with such fossils as Palæocampa.—O. F. Cook.

Monrovia, 1 Feb., 1896.

North American Crambidæ.—Dr. C. H. Fernald publishes as a bulletin from the Massachusetts Agricultural College an important Monograph of the Crambidæ of North America. The author has long been recognized as tne leading authority on the micro-lepidoptera. The new genera Eugrotea and Pseudoschœnobius are characterized as well as several new species. The bulletin is admirably illustrated by three plates in black and white and six plates in colors, beautifully printed. This will certainly prove one of the most satisfactory entomological publications ever issued from the Agricultural Colleges.

[2] Pocock, Ann. Mus. Civ. Genova, XXXIV, 506.

[3] *Polyxenus longisetis*, Journ. Linn. Soc., XXIV, 474.

New Mallophaga.—Much the most important paper as yet published in America concerning the Mallophaga is the recent contribution from the Hopkins Seaside Laboratory, in which Prof. V. L. Kellogg treats of New Mallophaga, with special reference to a collection made from Maritime birds of the Bay of Monterey, California. In the 140 pages of print the author presents descriptions and figures of one new genus and thirty-eight new species of Mallophaga, together with twenty-two species previously described by European authors, but now, with few exceptions, first determined as parasites of American birds. In addition, the paper contains an excellent general account of the Mallophaga and fourteen admirable plates. It can be obtained for 50 cents by addressing The Registrar, Stanford University, California.

Entomological Notes.—Professor D. S. Kellicott publishes[4] the second part of his excellent Catalogue of the Odonata of Ohio. It deals especially with the species of the southern part of the State.

In Bulletin 32 of the Iowa Experiment Station, Messers. Osborn and Mally treat of the chinch bug, four-spotted pea-weevil, the imbricated snout-beetle and other injurious species.

Bulletin 62 of the Virginia Station contains a discussion of the San Jose Scale, by Wm. B. Alwood.

In Bulletin No. 2 of the Technical Series from the U. S. Division of Entomology, Mr. L. O. Howard publishes a careful account of The Grass and Grain Joint-worm Flies and their Allies, being a consideration of some North American Phytophagic Eurytyminæ.

In the issue of the Entomologist's Record for May 1st Mr. J. W. Tutt begins an interesting series of articles upon Mimicry.

In Bulletin 69 of the Ohio Station, the Chinch Bug is discussed at length F. M. Webster.

Prof. S. W. Williston publishes a useful Bibliography of North American Dipterology, 1878–1895, in the January Kansas University Quarterly. In the same issue W. G. Snow gives a List of Asilidæ supplementary to Osten Sackens Catalogue of North American Diptera, 1878–1895.

[4] Jour. Cin. Soc. Nat. Hist., XVIII, 105–114.

EMBRYOLOGY.[1]

Protoplasmic Continuity.—Prof. Hammar, of Upsala,[2] emphasizes by figures and description the connection of the cells of the egg of a cleaving sea urchin known to Selenka and others, but hitherto regarded as of no importance. He finds a thin outer layer on the cells of the early and later cleavage cells and even on the cells of the blastula. This layer is seen both in living and in preserved and sectioned material. Its appearance is not that of a membrane but, the author thinks, rather that of an "ectoplasmic" outer part of the protoplasm of the cell. This outer layer is very thin and might be easily overlooked.

It extends continuously over the entire egg and as it seems to be a part of each cell, all the cells are thus held together by a continuous outer pellicle that the author thinks is a protoplasmic layer.

This actual connection of the cells at their outer surfaces, if really a protoplasmic connection, should, as the author insists, be of great importance in the interpretation of the results of experimentation upon echinoderm eggs. He suggests that it offers a suggestion towards the explanation of the interaction believed to exist between the cells of a cleaving egg. Moreover such a connection would make clear why very different results have been obtained after shaking eggs and separating the cells *more or less.*

Cell Studies in Annelid Eggs.—Prof. E. Korschelt, of Marburg,[3] has made a most detailed and thorough study of the maturation and fertilization of the eggs of the small polychætous annelid, *Ophryotrocha puerilis* with special reference to the number of chromosomes concerned in cell divisions at different phases of the life history.

Many of the interesting facts described cannot be here referred to, but only some of those that bear upon the question of the value of chromosomes as permanent individuals.

The number of chromosomes found in dividing cells in the adult is *four*, in certain ectodermal, entodermal and mesodermal structures. This same number is found in the cells of the ovary and of the testis, the ancestors of the eggs and sperms. The same number is found in

[1] Edited by E. A. Andrews, Baltimore, Md., to whom abstracts reviews and preliminary notes may be sent.

[2] Archiv f. mik. Anat., Marz 2, 1896.

[3] Zeit. f. wiss. Zool. 60, Dec. 31, 1895, pps. 543--680, pls. 28--34.

the early stages of cleavage and, as a rule, in the later stages and in the blastula, but in the later stages of cleavage and in the blastula there are often cells that contain *eight*.

In the maturation of the egg four chromosomes come out of the net work of the resting nucleus and eventually four go into the first polar body and two into the second. This is brought about as follows: The four very long chromosome loops shorten and divide lengthwise into four cleft rods. When these come to the equatorial region of the first maturation spindle they have again closed together so as to form four simple rods. These separate in pairs and move towards the poles of the spindle without presenting any true mitotic division. The first maturation division is, therefore, a reducing division. Yet the first polar body receives four chromosomes, since the pair that approaches that pole divides, as if opening out where previously split, and thus four rods are formed. The same takes place at the inner pole and four are left for the second maturation spindle. In the second polar body two chromosomes enter by moving away from the other two left in the egg. As it cannot be determined whether the pair entering the second polar body are two halves of one of original ones or halves of two original ones it is not certain whether the second maturation division is a reducing or an equating division.

Though the chromosomes are usually short rods or elongated granules during the maturation division, there are many eggs in which they appear as long, bent or horse-shoe shaped rods.

Some exceptions to the above account must be emphasized as showing the inconstancy of number of chromosomes resulting from lack of synchrony between chromosomal divisions and other phenomena of the cell.

Thus in some cases the first polar body has but *two* chromosomes, since the preceding division of chromosomes is left out. In others *eight* chromosomes are found at the equator of the first polar spindle, formed by a precocious division of the four chromosomes!

Fertilization takes place normally just after the eggs are laid and the sperm enters, while the first maturation spindle is still patent. In abnormal cases fertilization may take place inside the parent which is hermaphrodite and may ripen sperms and eggs simultaneously. Such cases, however, lead to abnormal cleavages and even to fusion of separate eggs, and seem due to some pathological state of the egg.

When the sperm enters the egg radiations are formed behind it, and later in front of it, so that the middle piece of the sperm may be re-

garded as introducing the centrosome or the archoplasm, and it is probable that the sperm revolves through 180°.

The male and the female pronuclei both move toward the centre of the egg and combine, but not till they have both gone through complex and similar changes, including the appearance and dissolution of an enormous nucleolus. The two nuclei finally fuse when each contains *two* long, thread-like chromosomes.

The centrosome or archoplasm of the maturation spindle disappears and that of the sperm divides and furnishes the first cleavage spindle. At the equator of this spindle are found the four chromosomes, two of male and two of female origin. Each splits lengthwise and the eight separate, so that each daughter nucleus obtains two chromosomes of male and two of female origin.

For many important facts not mentioned here the reader is referred to the two hundred remarkably clear figures and the judicial statements found in the original.

PSYCHOLOGY.

A Study in Morbid Psychology, with some reflections.— (*Continued from page 518*). With regard to the religious (?) experiences of Ansel Bourne, I am not so shallow as to think we can determine in the case of hallucinatory voices whether or no the phenomena are entirely subjective. An attitude of what the late G. J. Romanes has called " pure agnosticism " seems the only philosophical one in these difficult cases.[1] There has arisen a dogmatism in science as narrow and as mischievous as that of the straitest sect amongst theologians.

[1] "No one is entitled to deny the possibility of what may be termed an organ of spiritual discernment. In fact to do so would be to vacate the position of pure agnositicism *in toto*, and this even if there were no objective or strictly scientific evidence in favour of such an organ, such as we have in the lives of the saints, and in a lower degree, in the universality of the religions sentiment." A Candid Examination of Religion, p. 149, G. J. Romanes.

"Scientific men, as a class, are quite as dogmatic as the strictest sect of theologians. They professed to be agnostics, at the very time they were egregiously violating that philosophy by their conduct." Ibid., pp. 107–9.

But we can, I think, establish it as a law that "supernatural revelations" invariably take their colour from the preconceived ideas of the recipients. Probably, upon any hypothesis, they could do no otherwise.

One antecedent factor, in sudden conversions from the worldly to the religious life is often found in the physical effect of a severe illness; also those who have been rich in spiritual (?) experiences have often had indifferent health from childhood, with a liability to neurotic attacks. But there are too many exceptions to spiritual (?) experiences being the result of either temporary or permanent ill health, to enable us to say that such experiences are simply the result of disordered health, though they may be coincident with it.

I suppose that Socrates would universally be accepted as a type of moral and physical healthiness. Yet throughout his life he was subject to the promptings of what he himself calls an "inner, divine voice," which warned him if any evil were likely to befall him. In his sublime address to the judges who had just condemned him to die Socrates said that his "inner divine voice" had given him no warning of evil when he had left his house that day on which he was condemned to death, yet as it had always hitherto warned him of danger even on the most trifling occasions, he took its silence to mean that death was a good and not an evil. For even if death be a dreamless sleep, is it not a real and precious boon; and if it be as some say (and as Socrates himself hoped) only a passage from one state of being to another, to a place where all who have left this life are assembled, what greater good could man desire? To attain such happiness, Socrates would himself die many times.[2] Only in his own mind could the great philosopher seek for evidence of the one Supreme Being; for he could not believe in the popular theology which accepted gods who had committed acts which would have been disgraceful in the vilest of men. Therefore, it is not surprising that his "inner divine voice" did not profess to come from any supernatural power, but simply warned him of evil.

In the case of Mahomet we have a man of great strength of constitution, but one who was subject to strange attack, whether of epilepsy, catalepsy or hysteria is still a subject of doubt. What is certain is that he had a tendency to see visions, and suffered from fits which threw him at times into a swoon *without loss of inner consciousness.*

Through his intercourse with certain holy ascetics of the desert known as Hanifs, Mahomet became possessed with a profound sense of dependence on the omnipresent and omnipotent God. He withdrew to

[2] Apologia, XXXI, XXXII.

the solitudes of the bare and desolate Mount Hira, and meditated there with prayers and ascetic exercises. This state of things continued for many years, when in the month of Ramadan [which it will be remembered entails the severest form of fasting] the final revelation came which converted an illiterate Cameldriver[3] into one of the great religious teachers of the world. As he was repeating his pious exercises and meditations on Mount Hira the "divine voice" came to him. The angel Gabriel held a silken scroll before him, and bade him, though he could not read, recite what stood written in it. The words with which Gabriel had summoned him remained graven on his heart, and are found—as Mahomet at least imagined he heard them—in the 96th Sura of the Koran.

Mahomet returned to his wife Khadijah in great distress imagining he was possessed. But she comforted him and impressed upon him the belief that he had received a message from God.

Yet his doubts returned again and again, and reached a distressing height so that he was tempted to cast himself down from Mount Hira and this conflict lasted for two or three years.

Then one day he came to Khadijah in a state of great excitement exclaiming "Wrap me up, wrap me up!" (which was done when he fell into a fit, or swoon) and then the angel Gabriel appeared a second time, and revealed to him the Sura beginning "O thou enwrapped one!" [4] Henceforth there was no interruption and no doubt, the revelations followed without a break, and the Prophet was assured of his vocation.

The revolt of the idolatrous arabs against a creed of pure monotheism caused Mahomet at one time to yield to the temptation to humour them, and this temptation took the form of voice from the evil one, causing him to say in the pulpit that two of the heathen goddesses were sublime beings whose "intercession might be hoped for." His auditors were surprised and delighted, but the prophet went home disquieted. In the evening Gabriel came to him and Mahomet repeated the new *Sura*, whereupon the angel said "What hast thou done? Thou hast spoken in the ears of the people words I never gave thee." Mahomet now fell into deep distress fearing to be cast out from the Lord. But the Lord took him back to his grace and raised him up; the *Sura* of diabolical suggestion was erased, and the fury of the idolatrous party broke out with fresh violence. Mahomet was long and salutarily humbled by the remembrance of his temptation and fall, but he never abandoned faith

[3] It is still a subject of dispute amongst Moslems whether Mahomet could read it seems, however, more probable that he could not.

[4] Sura, 75 of the Koran.

in his vocation, and through evil report and good report believed that he had a Divine message to deliver.

The earliest and simplest accounts of the life of Buddha [Siddhartha Gautama] all agree in describing the four visions which led to the renunication, by that religious teacher, of all the greatest goods the heart of man could desire. Some accounts make all four visions appear on the same day, others on different days, but all agree is making the four visions phantoms which were visible only to Buddha and his charioteer Channa. As Buddha was driving in his pleasure grounds he was struck by the sight of a man utterly broken down with age; on another occasion by the sight of a man suffering from a loathsome disease, and some time afterwards by the horrible sight of a decomposing corpse. Then an ascetic appeared walking in a calm and dignified manner, and the charioteer explained to the young prince the character and aims of the ascetics.

[5]" Subjectively though not objectively," says Mr. Rhys Davids, " these visions may be supposed to have appeared to Gautama," and undoubtedly at this time the mind of the young Rajput had become deeply stirred. The birth of his son did not deter Gautama from his resolution to lead an ascetic life, so that he might some days return to his loved ones not only as husband and father but as teacher and saviour; and on the night of the full moon in the month of July the young chief left his father's home, his wealth and power, his wife and child behind him, and with Channa as his sole companion, went out into the wilderness to become a penniless and despised student and a homeless wanderer. It would take too long here to attempt to explain the reasons which made the visions of Buddha naturally relate to the sorrows and emptiness of life, and not to the joys and promises of a future state. The great object to be attained was to put an end for ever to the cycle of births and deaths to which all human beings were considered subject, and to pass this life in such a manner that complete absorption into the World-Soul (Nirvana) should follow death.[6] The aim was *not* that conscious personal immortality, or that rejoicing in the love of a God who loves his creatures, which is the strong desire of the heart of Western peoples.

But in order to teach (what to him seemed) the way of salvation to his fellow creatures, Gautama made the greatest and most complete self sacrifice ever recorded of any human being; and for this great renunciation his memory cannot be too highly honored.

[5] T. W. Rhys Davids, Buddhism. Enc. Bri., Vol. IV.

[6] The Nirvana of Buddhism is simply extinction, op. cit., p. 434, and note 1.

Augustine, the great Bishop of Hippo may be taken as a type of the '*mens sana in corpore sano.*' He was a man who drank deeply of all joys, both of the body and the mind, which the cup of life could offer. Yet his great powers and commanding intellect did not prevent his hearing a " divine voice " which then and there influenced him to take up the religious life. It is true that the mind of Augustine had been deeply exercised by the search for truth, which ever seemed to elude his grasp. Plato and St. Paul opened the way for higher thoughts, and words of the latter were driven home with irresistible force to his conscience, as with his friend Alypias he was studying the Pauline epistles. The thought of divine purity fought in his heart, with the love of the world and of the flesh which were sore temptations to a man so admirably fitted to enjoy both. He burst into a flood of tears, and going out into the garden flung himself under a fig tree that he might give his tears full vent, and pour out his heart to God. Suddenly he heard a voice calling him to consult the scriptures. "Take up and read, take up and read." He left off weeping, rose up and returning to his house took up the volume from Alypius, and read in silence the words to be found in Romans XIII, 13th and 14th verses. Augustine adds "I had neither desire nor need to read further. As I finished the sentence the light of peace had poured into my heart and all the shadows of doubt dispersed. Thus hast Thou converted me to Thee . . . standing fast in that rule of faith which Thou so many years before had revealed to my mother." (Confessions, VIII, 30). This appears to have been the only occasion when a hallucinatory (?) voice was heard by Augustine, but its influence lasted for his whole life.

For that experience which points to the state commonly known as ecstacy,[7] I shall take the experience, not of a saint, nor of a prophet, but of a plain American citizen of our own day, a locomotive engineer who worked chiefly in Ohio and Indiana.

[7] Neoplatonism was a philosophical religion, in no way founded on any revelation real or imagined. Its great expounder Plotinus says simply of his own experience of "ecstacy" [that is of the sense of absorption into the Divine Beings] " I myself have experienced it but three times." But his pupil and disciple Porphyry says that on four occasions during the six years of their intercourse Plotinus attained to the ecstatic union with God.

It is surely contrary to the true scientific spirit to ignore this strong, overmastering instinct of the human mind towards union with some "Power, not itself, which makes for righteousness," and which appears in equal strength in the Hindoo, the Mahometan, the mediæval saints, the German mystics; and in the Neoplatonists—who had no "religious superstition" to influence them, and no hell to terrify them, but who were possessed only with the sense of an overwhelming need for union with the Divine.

This engineer, whose name was Skilton, was engaged with two other men in unloading a freight car. Just as he had lifted a barrel out to the platform he saw a "person standing" "on his right hand clothed in white" "and with a bright countenance"; and "putting his hand on my shoulder." "He said 'Follow me'." A long description ensues of the happy and beautiful place to which this personage led him; a place where the inhabitants did not converse by sound but knew each other's thoughts on the instant, and where he saw his mother, his sisters and his child. In fact the heaven it was natural for the percipient to to imagine, though—be it remarked not the heaven of harps and white nightgowns of popular theology—but such a heaven as the seer might naturally desire. Mr. Skilton describes the earth on his return as appearing to be seen from a great height, trees buildings, etc., gradually came into sight, and finally he reached the car which he had begun to unload, and then the guide vanished. "I spoke then" he says (just as I opened my watch and found it had been just twenty-six minutes that I had been engaged with that mysterious one) and said I thought I had left this world for good. One of the men said: "There is something the matter with you ever since you opened the car door; we havn't been able to get a word out of you" and that I had done all the work of taking out everything, and putting it back into the car. I told them where I had been and what I had seen, but they had seen no one. He adds: "This I count the brightest day of my life, and what I saw is worth a life time of hardship and toil. Being in good health, and busy about my work and my mind not more than ordinarily engaged on the great subject of eternal life, I consider this a most extraordinary incident."[8]

If it be said there is no corroboration of Mr. Skilton's statements neither is there any corroboration of any other similar statement; and if I have chosen his experience from among many others, it is simply to show that whatever religions (?) experiences occurred to persons in past times, *occur in precisely the same way now.*[9]

As an exemplification of the law that all spiritual (?) experiences are coloured by the prepossessions of the percipients, I may take the numerous cases of the alleged appearances of the Virgin Mary. The apparition to Bernadette Soubirons is only one amongst many, and in this case as in most others expectant attention is not a factor. The Virgin appeared to Bernadette when she was certainly not expecting to

[8] Communicated to Professor James of Harvard by Mr. Skilton.

[9] The exaggerations found in *legendary* times constitute a totally different branch of study.

see anything; and the crowds of pilgrims who have gone to Lourdes in a state of vivid expectant attention have seen nothing.

I have no space to describe the many instances I have met with of recent appearance of the Virgin Mary, under circumstances where there can be no reasonable doubt of the good faith of the percipients, nor do I recall any circumstances of religions exaltation accompanying these visions. Where pious Catholics see the Virgin Mary or the saints, equally devout Protestants see Christ or an angel, and both see spirits which they believe to be those of the blessed dead.

My own mind in regard to the question of religions experiences is in the state of suspense of judgment,—the state of "pure agnosticism" advocated by G. J. Romanes. [I need hardly say that this is *not* the agnosticism of scientific orthodoxy].

If in the present stage of our study of these phenomena we leave the stage of pure agnosticism, one of two hypotheses must, it seems to me, be accepted. Either such experiences are due (*in persons otherwise rational and capable of carrying out the business of life*) to some "organ of spiritual experience," or they are *all* in the domain of morbid psychology. The evidence is of a similar nature in all these cases, whether of Paul, or Mahomet, or Ansel Bourne, or Bunyan or Socrates or Mr. Skilton; the hallucination (?) visual or auditory or both is only manifest to the percipient, and to him appears objective. In the case of what are called "collective hallucinations"—which are not uncommon, we have also only the evidence of the percipients, who see what others do not see. The great difficulty in accepting the hypothesis that there is some real communication possible from "a Power not ourselves which makes for righteousness," is the frequent association of religions hallucinations with insanity. But if there be an "organ of spiritual insight" it can act only subject to the general functions of the organism, and must be liable to partake of its disorders; it can only be the frail machinery through which an Unknown Energy is acting.

So I leave the question, the most important, it seems to me, with which Science can deal. The history of Ansel Bourne is extracted from the Proceedings of the Society for Psychical Research.

ALICE BODINGTON.

ANTHROPOLOGY.[1]

Mr. Keane on Paleolithic Man.—Mr. A. H. Keane in his recent publication "Ethnology" takes serious exception to my denial of there having been a paleolithic period, and says "Paleolithic necessarily antedates Neolithic Culture." In what does this necessity consist? Why should Paleolithic precede Neolithic Culture? The names it is true signify old and new, but are at best arbitrary, being a suggestion of Sir John Lubbock to distinguish a supposed "chipped" from a "polished" stone period. Mr. Keane says "where there is a time sequence, the chipped stones being of ruder and simpler formation, naturally precede the more perfected polished objects." The proof of a "time sequence" is by no means a settled question, this assertion being negatived in one way or another by every writer on Archeology. The chipped stones are not "ruder" than polished stones, nor are they "simpler" in shape, material or facility with which the shape may be given. I have only attempted to discuss the subject from a technical standpoint and from the writings on the subject generally, from either of these points, however, or from both together I contend my position is sustained. Chipping stone is a more difficult mechanical process than grinding and pecking stone, it is more complicated in its minutiæ, involving, it is true, blows with a hammer, the difference being that the chipper's blow is of necessity more deliberate, slower and of necessity more accurate than the blow given in pecking. A doubt of the accuracy of this proposition may be solved by taking a flint and a diorite and attempting with any hammer to shape them. If ordinarily careful the diorite will be worn into shape, while on the other hand the chances are many to one that the flint is destroyed before completion.

Mr. Keane objects that "European archeologists are asked to reconsider their own conclusions." Undue weight being shown to have been given certain evidence, European archeologists owe it to themselves to reconsider their conclusions. Up to a recent period it was believed generally that to shape a Neolith or ground implement was more difficult than it was to shape a Paleolith or chipped implement, and such difficulty was used as the main evidence upon which to support the theory of a chipped preceding a polished stone age. Having been shown that the contrary was the case, one would presume

[1] This department is edited by H. C. Mercer, University of Pennsylvania.

European archeologists would seek to examine their error without being forced to do so. Mr. Keane says "There is necessarily a time sequence wherever the two cultures have been developed." The mistake the author falls into is in declaring that to chip a stone or to grind and peck a stone constitute two cultures, for experiment proves the contrary; try to chip a diorite and you only shape it by powdering the surface, for it does not chip, try to batter a flint and it breaks through the ordinary lines of cleavage and is destroyed, for it does not peck.

Again the author of Ethnology says "that until it is shown that fire arms are as old as paleoliths, no European archeologist will ever believe that polished implements are as old as the chipped stones." Though this will hardly pass as scientific argument we would say, here again Mr. Keane is in error, for instances of chipped and polished stones being found in the same layer with fossil bones has been recorded on too many occasions to leave room for doubt to one who would decide on written authority alone. Up to this time Mr. Keane has argued in favor of the simpler process preceding the complex, but here he says "it is a fallacy to suppose that the easier process comes first," and instances "transport by wheeled vehicles or by steam as immeasurably easier than pack animals." If we are to construe the word "easier" as being synonomous with "simpler" it opens a new field of argument to assert that the complex precedes the simple in machinery, or that the machine of many parts is the ancestor of the machine of few parts, this proposition will not meet with many supporters.

My views concerning the mechanical status of primitive peoples has been formed solely from experiment with primitive tools and reading the literature of archeology. The technology of archeology appears to be little understood in Europe, its importance being almost ignored, as is evidenced by the apparent inability to grasp the plainest mechanical propositions. The results of my experiments are sustained by my field discoveries as they are by research in the library, and considered from any of these positions the fact that an identical mechanical culture produced, chipped or polished stone appears to be indisputable. The earliest cave remains show man to have made the best use of material at his command. Where he had flint he chipped it; if on the contrary he lived in a region of metomorphic stone he would of necessity hammer it into shape; if horn and ivory were plentiful he would saw and grind it. If one will make experiments with primitive implements in reproducing primitive work they will not fail to appreciate the correctness of the views here expressed. As illustration take

material from Magdalen Cave, from Les Eyzies, from St. Acheul, from Moustier, from Chelles, even from Cissbury or from where one will, and try to make from it arrow heads of a different type from that usually found in the locality from which the material is brought and examine the result. One finds that flint chips within certain limits, for it depends even more on the material than on the workman as to the shapes the nodules work into. The difference in the tool with which the stone is worked is secondary to the texture of the stone. One of the best illustrations of this is in the obsidian spear heads from Easter Island. They are of a gritty texture, extremely rude, fully as rude as the rudest paleolith, and are chipped almost entirely from one side. Try to improve the shape of one of these implements and rude as they are, failure is the inevitable result; try to chip it from the wrong side and it breaks through and destroys the specimen, the best and most expert workman cannot improve its shape. Take, however, one of the obsidians from Mexico of even texture and to shape it in most graceful form is most easy, but with such material it would be almost impossible to imitate the rough arrow heads of Easter Island. The same stone varies enormously in its fracture in different layers, yet archeologists do not appear to have noticed the fact.

Only a few years since it was argued that paleolithic man was primitive man, man low in the scale of human development, to-day paleolithic man is apparently only primitive as a flint chipper, but an artist as a bone or ivory worker; the fact that technically considered the work necessary to shape a so-called "Baton of Command," itself probably a chipping tool, was identical with the chief work on the neolith (grinding) does not appear to be appreciated by those who believe in a paleolithic period. Five years ago or little more it was hotly denied that pottery belonged to the paleolithic period, and this was insisted upon until the accumulation of proof was so overwhelming that by many it was admitted, yet even now many deny that pottery is as ancient as many of the paleolithic cave strata.

J. D. McGuire.

Cave Exploration by the University of Pennsylvania in Tennessee.—*Preliminary Report.*—To learn that the remains of Plistocene Man have been abundantly found in the caves of Europe; that equally significant remains of later savage, barbarous and civilized peoples have been similarly discovered in the caves of Europe, Asia and Africa; and that the remains of the Indian and the recent White Man have been found in caverns in North

America; warrants the supposition, that in the subterranean floor deposits of the new world, the problematic existence of Plistocene Man might be soonest and easiest demonstrated, while with hardly less ground we may urge as valuable testimony in the American region the absence of such remains in significant underground shelters. Not unreasonably such absence, occurring invariably at these immemorial halting places of men and animals, might indicate that Plistocene Man had never existed in the adjacent regions.

By this course of reasoning and investigation the University of Pennsylvania has sought to solve definitely the question first to attract and last to puzzle American students—How long has Man existed in the New World? Striving to limit the speculations of archæologists, the work has proceeded by degrees to reconcile with geology their study of pre-Columbian peoples, which, fascinating as it is, has lacked thus far subdivisions, landmarks and starting point, while an effort to eliminate, through the investigation of significant caves, one region after another from the field of search, has sought to narrow the area of possible discovery from the point of view explained. Having shown on the one hand that certain caverns like the fissure at Port Kennedy, (right bank of Schuylkill River, 3 miles below mouth of Perkiomen Creek, Montgomery County, Penna.,) containing in large quantity the remains of Plistocene animals without relics of Man, are geologically ancient, on the other hand, a fact of much significance has been demonstrated for the first time, namely, that a considerable number of other caves are modern, since their floors, well supplied with the refuse of Indians and later White Men, below which remains of geologically older peoples would not have been lacking in Europe, have failed to reveal any relic of Plistocene Man.

In these several instances the geologically modern remains (human) and the geologically ancient remains (animal) have lain apart in distinct caves, and hence less availably for comparative study, but the recent expedition in Tennessee, resulting in the examination of three caves in which the old and new deposits lay in juxtaposition, has enabled us to push the question farthur by studying the relation between the ancient and modern strata where, at their point of contact, it was most significant.

More broken and scattered even than at the remarkable tomb of extinct animals at Port Kennedy, were the remains of the Tapir, Peccary, Bear and smaller Mammalia at Zirkel's Cave, (left bank of Dumpling Creek, about 5 miles above its mouth in French Broad

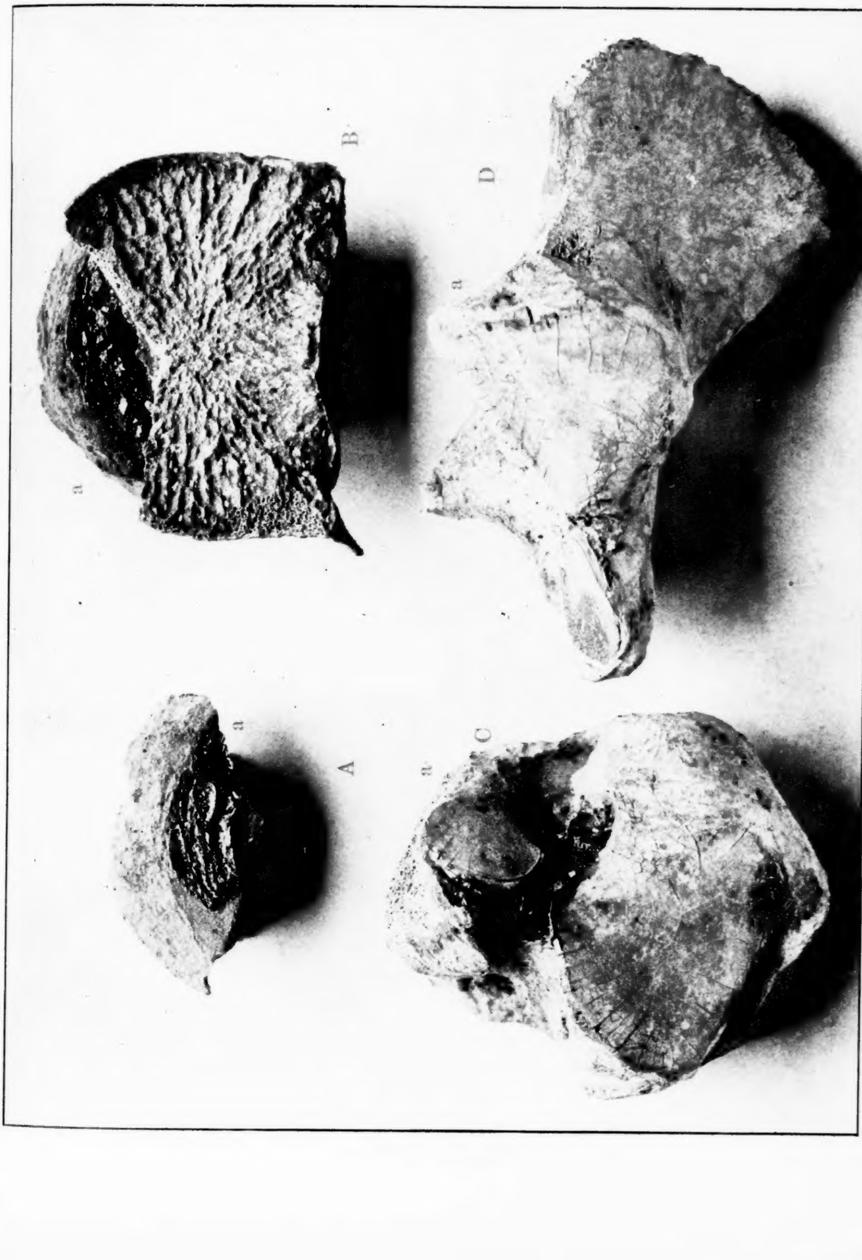
River, Jefferson County, Tennessee,) visited by Professor Cope in 1869. Dislocated as before after the flesh had rotted, the bones were crushed by a force which had split them into fragments, and were deposited with a mass of clay mixed with lime, which filled the descending cave. Hardened finally into breccia not easily broken with the pickaxe, this bone bearing earth had disappeared at many points to make room for a deposit of cave earth containing the remains of the Rattlesnake, Woodchuck, Opossum, Rabbit and Cave Rat. It is the important relation of this latter modern earth, with its bits of mica and Indian pottery, to the older breccia that will constitute the material for a final report.

Previous examination, in 1893, at the Lookout Cave, (left bank of the Tennessee River, one-quarter of a mile below Chattanooga Creek, Hamilton County, Tennessee,) had revealed the bones of the Tapir and Mylodon in the lowermost zone of a floor deposit of Indian refuse, and upon the recent expedition the cave earth with its "culture layer" was entirely removed for 58 feet inward from the entrance to settle beyond doubt the relation of these fossils to the Indian remains resting upon them. At this significant spot, where again the Plistocene and recent deposits lay in contact, and where the specimens found were labeled according to their position, whether from the black (modern) earth above or the yellow (ancient) earth below, a completed examination should decide whether Man had or had not encountered the Tapir and Mylodon in the Valley of the Tennessee.

After a visit to "Indian Cave" on the Holston River, Carrol's Cave, and the Copperas and Bone Caves, near Tullahoma and Manchester, Tennessee, a new set of conditions was presented at Big Bone Cave (1 mile from the left bank of Caney Fork and about 2 miles above its mouth in Rocky River, Van Buren County, Tennessee.) There the bones of the Gigantic Fossil Sloth (*Megalonyx*,) still retaining their cartilages, were exhumed from a dry deposit of the refuse of Porcupines and Cave Rats, mingled with fragments of reeds used as torches by Indians in a gallery 900 feet from the entrance, thus presenting us in the final summing up of this strange evidence a new notion of the relation of the modern Indian to this extinct animal, whose remains outnumber all its fossil contemporaries at Port Kennedy.

Thanks are due to Dr. William Pepper, to the Board of Managers and to Professor E. D. Cope for their kind co-operation in the expedition thus finished, which, at a cost of $300, has presented the Museum with the specimens now under examination. These, if not attractive,

PLATE XI.



Megalonyx jeffersonii with articular cartilages at a. A, B, Vertebral epiphyses. C, Astragalus. D, Calcaneum.

are important. For Paleontology they mark in the bone breccia of Zirkel's Cave, a distinct stage in the Plistocene series, while for Anthropology they represent data which account for the presence of Man together with the bones of the extinct *Megalonyx*. They explain the relics of savages and the remains of Plistocene mammals at two caves situated in the Eastern Valley of Tennessee at a height of about 600 to 700 feet above the sea and within earlier reach of an overwhelming ocean in Champlain time, and again at a third cave, which, 300 feet higher on the continental floor and looking westward from the slopes of the Cumberland table-land, stands for that part of the Appalachian region whither animals and Man (if he existed) might have found convenient refuge when lower areas sunk, as is alleged, beneath the level of the invading waters.—HENRY C. MERCER.

Aldie, June 4, 1896.

SCIENTIFIC NEWS.

The proposed general synopsis of the Animal Kingdom (Das Thierreich) to be issued by the German Zoological Society, is one of the greatest undertakings ever planned in the line of bookmaking. It is proposed to give a short general account of each group, and following this is a synopsis of all existing forms, including those which have recently become extinct. The general editor of the whole series is Prof. Franz Eilhard Schulze of the University of Berlin, and he is assisted by the following department editors: Prof. O. Bütschli, Protozoa; Prof. C. Chun, Coelenterata; Prof. M. Braun, Plathelminthes; Prof. J. W. Spengel, Vermes; Dr. W. Kobelt, Mollusca; Dr. W. Giesbrecht, Crustacea; Prof. R. Latzel, Myriapoda; Prof. F. Dahl, Arachnida; Dr. H. Krauss, Orthoptera; Mr. A. Handlirsch, Neuroptera, Hemiptera; Dr. H. J. Kolbe, Coleoptera; Prof. C. W. Della Torre, Hymenoptera; Dr. A. Seitz, Lepidoptera; Prof. J. Mik, Diptera; Prof. F. Blochmann, Brachiopoda; Prof. E. Ehlers, Polyzoa; Prof. J. W. Spengel, Tunicata; Dr. G. Pfeffer, Fishes; Dr. O. Boettger, Batrachia and Reptila; Prof. A. Reichenow, Birds, and Prof. L. Döderlein, Mammals. These will be assisted by a host of collaborators for special groups, and the names of these, as far as announced, assures us of the

most authoritative treatment. The whole work will be of enormous extent, and it is estimated that it will take twenty-five years for its completion. It will be issued in parts of an average size of 48 pages, and the price charged to subscribers for the whole series will be 70 pf. (17½ cents) for each "signature" of 16 pages; single subjects will be sold at an advance of ⅓ above this price. It is estimated that the Flatworms will occupy 4 parts; the Crustacea 11, the Hymenoptera 13; the Mollusca 15, the Reptiles 3, and the Birds 16. The total will be over 120,000 pages, and the series, when complete, in large octavos, will occupy not far from 30 feet of shelf room. The publishers of the series are the well-known R. Friedländer & Sohn, of Berlin, and they have already issued a sample number, embracing the group of Heliozoa, treated by Dr. F. Schaudim, of Berlin. This occupies 24 pages. It is expected to begin regular publication with the year 1897, and the parts will be issued as fast as possible, without regard to their sequence in the whole work.

It will probably be interesting to know that a party of five from Cornell, under the direction of R. S. Tarr, will accompany Lieut. Peary on the trip to Greenland this summer. The party will be so constituted that the results will cover the several fields of natural history, although the main object will be the study of geology, and especially glaciation.

The next meeting of the American Microscopical Society, August 18–20th next, is to be held in the Carnegie Library Building, Pittsburg. The local Committee on Arrangements is organized: C. C. Mellor, Chairman; Mayness Pflaum, Secretary and Treasurer, and C. G. Neilnor, Chairman Finance Committee, either of whom will be glad to give members and others desiring to attend all necessary information. As soon as sufficient arrangements are made, special announcements will be mailed to all members.

Dr. R. Wagner, of Strassburg, has been appointed assistant in Vegetable Physiology in the University of Munich, and Dr. A. Y. Grevillius, of Upsala, assistant in Botany at Minster.

The Royal Belgian Academy of Sciences has recently elected Professors E. Strasburger, E. D. Cope, E. J. Marey and Sir A. Geikie to honorary membership.

Prof. M. Treub, Director of the Botanical Gardens, at Buitenzorg, who has been spending some time in Europe, has returned to Java.

Dr. A. Fleischmann has been advanced to the position of Extraordinary Professor of Zoology in the University of Erlangen.

The Royal Irish Academy recently elected Sir Joseph Lister, T. G. Bonney and Sir W. H. Flower to honorary membership.

Dr. G. A. J. A. Ondermann, Professor of Botany in the University of Amsterdam, has retired on account of his great age.

Mr. A. Lawson, botanist and director of the Cinchona plantations in the Madras district, died at Madras, February 14th.

Prof. D. Barfurth, of Dorpat, goes to the University of Rostock as Ordinary Professor of Comparative Anatomy.

Dr. H. Ph. Foullon von Norbeck has been appointed Chief Geologist to the Austrian Geological Survey.

Dr. G. Rörig, of Berlin, goes to the University of Königsberg as Extraordinary Professor of Zoology.

Mr. H. M. Drummond-Hay, ornithologist and ichthyologist, died recently at Perth, Scotland, aged 82.

Dr. J. Briquet, of Genoa, has been appointed Director of the Delessert Herbarium in that city.

Mr. J. H. Ashworth succeeds Dr. Hurst as Lecturer on Zoology in Owens College, Manchester.

Mr. A. S. Olliff, entomologist, died in Sydney, N. S. W., December 29, 1895, aged 30 years.

W. L. Sclater, of Eton College, goes to Cape Town as Curator of the South African Museum.

Dr. Thilenius has been made privat docent in Anatomy in the University at Strassburg.

Dr. C. Herbert Hurst, of Manchester, goes to Dublin as assistant to Prof. A. C. Haddon.

Dr. A. Smirnow, of Kazan, goes to the University of Tomsk as Professor of Histology.

Col. Plunkett has been elected Director of the Science and Art Museum in Dublin.

Dr. A. Bogdanof, Professor of Zoology in the University of Moscow, died in April.

Dr. G. Fatta has been appointed assistant in the Botanical Institute at Palermo.

Dr. R. Oestreich is now privat docent in Anatomy in the University of Berlin.

Dr. Szymonowicz is privat docent in Histology in the University of Cracow.

Dr. Gruner, of Jena, goes on an expedition to Togo, German West Africa.

Prof. Ph. C. Sappey, the well known anatomist, died in Paris, March 13th.

A. Duvivier, student of Coleoptera, died in Brussels, Jan. 14, 1896.

F. Ludy, coleopterologist, died March 1st.